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A HYDRAULIC ANALOGY OF RADIATION.

Much has been written of late concerning the radiation of energy, but particularly respecting the forms which we recognize as light and heat. The scientific world is always deeply interested in this branch of physics, and just now the industrial world has been giving the subject considerable attention, primarily because of the endeavor to produce more efficient lamps, both gas and electric. Information respecting the form of these lamps and the reason why they are better than the older types is looked for eagerly. For a time new forms of lamps, particularly electric lamps, were put forward with sufficient frequency to keep the interest keyed up to a high point, and more recently those who are able to write upon the scientific phases of the problem of improving lamp efficiency have been giving the public the benefit of their knowledge.

Much has been said about selective radiation, an effect to which is attributed part, at least, of the better efficiency of the newer forms of lamp. But although certain of these lamps undoubtedly show selective radiation, it seems evident that their improvement depends more upon an increase in temperature. As the quantity of light radiated increases with the twelfth power of the temperature, but a slight increase in temperature is necessary to increase very considerably the amount of light; in fact, with an incandescent filament at about 2,000 degrees, an increase in temperature of 100 degrees centigrade will about double the amount of light delivered. Selective radiation, while it does take place, can not, therefore, be credited with much of the improvement, since it is known that the newer filaments are operated at a higher temperature than the old.

Nevertheless, the subject of selective radiation is of great interest, not only theoretically, but from a practical viewpoint, because it is only in this direction that we can hope to obtain efficiencies which would be respectable as compared with those of other transforming devices. Selective radiation is defined somewhat indefinitely as a radiation which does not follow the law of radiation followed by that hypothetical radiator, a black body. In other words, it generally refers to a form of radiation, the luminous rays of which bear a larger proportion to the whole than do those of the black body. The more selective the radiation, or, rather, the smaller the proportion of the heat waves, the better the efficiency. Just what the mechanism is which produces this result is not known, though it must, of course, depend upon the molecular structure of the radiating body. The subject is a little hard to understand at first, and therefore any suggestions tending to make it more comprehensible are welcome. A suggestion of this kind is made by Dr.

R. W. Wood, in *Nature,* April 11. He suggests a hydraulic analogy of the radiating body which serves to illustrate the radiation in general, and can be made to show how selective radiation would take place. Analogies must always be used with reserve, and no one who is not very familiar with all the phenomena exhibited during the action illustrated should attempt to make them or extend them further when suggested by others. But when used within the proper limits, they are a useful and instructive aid to the imagination.

Dr. Wood's analogy is a simple one, and while it does not show why radiation should be selective, it does show how it can be so. A radiating body is likened to a hollow vessel into which water is poured. This vessel is provided with openings at the bottom, through which the water issues. These openings may be of different sizes, thus corresponding to different wave-lengths of radiation. When water is poured into the vessel it will flow out from the openings at the bottom at a rate depending upon the height of water in the vessel; and if the rate of inflow be constant, the level of water in the vessel will finally reach a fixed point. This depth of water corresponds to the temperature of a radiating body, the liquid poured into it to the heat absorbed, and the water issuing from the lower openings to the radiations given out. Under fixed conditions the outflow is equal to the inflow. The larger openings correspond to the longer wave-lengths, and the smaller ones to the shorter. More water will, therefore, issue from the larger openings, and this corresponds to the greater radiation of energy from a hot body in the form of heat waves. Increasing the rate of inflow raises the height of water—that is to say, the temperature of the body—until this has reached such a point that the outpour again equals the inflow; but the larger wave-lengths—that is to say, the larger jets—will still represent the greater portion of the radiation.

Selective radiation may be represented by plugging up more or less tightly those openings which correspond to the rays which are given off in diminished quantity. The outflow from these openings will thus be diminished. The immediate result will be to decrease the rate of outpour of the entire vessel; therefore, the height of water—that is to say, the temperature—will increase until conditions again become stable. But now, although we may have the same outflow of energy or water, we have a higher temperature and a greater proportion of outflow in the smaller jets, corresponding to the shorter wave-lengths. Further, a good radiator must be a good absorber, and a selective radiator must also be a selective absorber. This may be illustrated by plunging our vessel, while empty, into a vessel of water and allowing the latter to flow into it through the openings at the bottom. If the larger openings are still plugged up, a greater absorption will take place through the smaller openings. This corresponds to the reflection of the longer wave-lengths.

The analogy is very pretty, since it shows clearly how a radiating body behaves. As mentioned above, it does not attempt to show why it behaves in this way. This effect may be due to several reasons. Selective radiation may take place on account of the molecular structure, or it may be due to a surface formation. The body, although made up of a material usually a good reflector, may be given such a form as to force it to absorb practically all the light which falls upon it. For example, a bundle of polished steel needles will absorb all of the beam of light falling upon their points, although the metal of each needle is a good reflector. The action is due to successive reflection from surface to surface until the radiation is entirely taken in. Such a body should act in the reverse sense, and thus become a good radiator.

Among other things, Dr. Wood mentions an interesting point. Transparent bodies are naturally poor radiators, yet these can be made to radiate. He found that beads of fused sodium pyrophosphate did not radiate at all, and if they are allowed to become cold, they become traversed by many cleavage planes and lose their transparency. Then, if re-heated, they radiate strongly until they again become fused. Air-bubbles enclosed within a transparent body also cause it to radiate. This effect has not been explained, but it is thought that it depends in some way upon a surface action.

ARTIFICIAL FERTILIZERS.

Of the various attempts to fix atmospheric nitrogen directly by the action of the electric arc, but one survives to-day—that is, the Birkeland and Eyde system, now in operation at Notodden, Norway, where there is a 2,000-horse-power plant which, it is reported, is running profitably. The success of this system seems to depend upon the method employed of spreading out the arc by means of a magnetic field, so that a comparatively large volume of air is exposed to the action of each arc. In this spark method, unfortunately, the energy is used in a very inefficient manner, only a few per cent of it being absorbed in bringing about a chemical combination.

A method which seems to be more effective, although it works indirectly, is that now being tried on a practical scale at several plants in Europe. This process has been referred to several times, but the information has been rather indefinite. At a recent meeting of the German Elektrotechnischer Verein, Dr. G. Erlwein gave some details which are of considerable interest. The process depends upon the reaction, observed first by Frank and Caro, which takes place when nitrogen is passed over heated carbides of the alkaline earths. These take up the nitrogen and form cyanide or cyanamide compounds. The method first used on a practical scale consisted in passing air over heated calcium carbide, but the high price of the carbide at that time led to a more direct treatment, the lime and coke being mixed together and heated, and, at a certain point, nitrogen was passed through the furnace. The furnace was constructed in a way somewhat similar to the carborundum furnace, but passages were left through the mass for the percolation of the nitrogen. More recently the price of carbide decreased, so that it could again be used as economically as the raw materials. It should be noted here that in this process there are two reactions: first, the formation of carbide; second, the conversion of this into cyanamide. In the spark process the result is a direct production of a weak solution of nitric acid, but this must be com-

bined with some base in order to make it useful for fertilizing purposes. In a sense, this method is then indirect also, and though it is very wasteful of energy, the final product does not even contain all of the energy taken up from the electric arc, for a good part of this is lost again when the acid reacts with the base. It is possible that this may have something to do with the better efficiency of the cyanamide process, but it seems more probable that the latter utilizes the heat of the electric current more efficiently in the first place, since the furnace can be comparatively well insulated.

The cyanamide process as now worked consists in heating calcium carbide and passing through this pure nitrogen obtained from the air either by passing it over heated copper or by fractional distillation of liquid air. This introduces another step in the process which must add considerably to the expense, but the results, no doubt, are much better than those obtained when the air was used directly. It is said that the cost of producing nitrogen from liquid air is about one cent per cubic metre. A ton of calcium carbide is now produced for about one-half kilowatt-year, and this will absorb over 500 pounds of nitrogen. In other words, it takes about two kilowatt-years to obtain one ton of nitrogen in the form of calcium cyanamide. This material is used directly as the fertilizer, as the calcium is itself beneficial. It is said that the energy required to produce a ton of combined nitrogen by means of the electric arc is about three times the figure just given. Plants for the manufacture of cyanamide are now projected for Dalmatia, France, Switzerland, Germany, Norway and this country.

THE SELF-EXTINGUISHING ARC.

One of the interesting phenomena observed in recent years in connection with high-potential transmission work is the formation of an electric arc due to an accident which burns out part of a high-tension cable. The arc thus formed goes out, reforms, and is again extinguished, the whole apparatus forming, in a sense, a low-frequency interrupter. This accident has occurred several times, generally with more or less damage to the system involved. The explanation of this peculiar phenomenon which has generally been accepted is that the arc formed after the burning of the cable amounted practically to a short-circuit on the system. A heavy current was thus drawn, but as the resistance of the arc is comparatively small as compared with the rest of the system, the voltage across the former fails to fall, and this is accentuated by the effect of the heavy load on the generators. As the potential decreases, a point is eventually reached when it is not sufficient to maintain the arc. The latter, in consequence, dies out. The sudden opening of the circuit then causes a rise of potential, which may carry it to a point above normal, and this causes a reformation of the arc. The process is repeated, the arc being formed and extinguished until finally stopped by some other means.

In an article contributed to *L'Éclairage Électrique,* April 13, by M. Paul Bary, there is an interesting study of the mechanical action of currents in electric conductors. This begins by calling attention to the action of a heavy current when flowing through a comparatively small liquid conductor, such as a narrow column of mercury. The ampere effect, which tends to draw together elementary currents, contracts the conductor until it finally causes it to separate and open the circuit. The stoppage of the current then allows the mercury to flow together again, when the action will be repeated. The device, in other words, acts as a rather poor interrupter. M. Bary has made a careful study of this effect, and believes that to it may be attributed the action of certain types of electrolytic interrupter. He has made use of the effect to pulverize metals, as metallic spray is formed at the moment of the break. He uses it also to study the rate of propagation of waves in liquids, for by using an alternating current, stationary waves may be produced in the conductor. He attributes the action of the singing arc and the phenomena observed in Geissler tubes, in part at least, to this effect, for if the magnetic force is sufficient to break a liquid conductor, it should much more easily break a gaseous conductor, the particles of which are much more mobile. The action with liquid conductors is only observed with comparatively large currents. When the current density is small the pressure exerted on the conductor, which is proportional to the square of the current, is not sufficient to cause the break. With gaseous conductors the effect should be produced with much smaller current values, and with still smaller ones in the case of the exhausted tube.

It seems possible that the periodic interruption which has been observed, as mentioned above, on high-tension power apparatus, may be due, in part at least, to this action described by M. Bary. We have here a heavy current, as is necessary. The fact that it is alternating does not alter the conditions, except to cause the pressure to become alternating, as the action is independent of the direction of the current. It suggests that a study of very heavy arcs in air would be not only interesting, but possibly productive of valuable results.

MOTOR-CAR SERVICE.

During the last year railway operators have given a lot of attention to light, self-propelled cars for supplementing their regular train service. These so-called motor-cars are light, yet capable of fairly high speed, and require but a small crew to operate them. They afford a means of giving frequent service on steam roads, thus enabling the latter to meet, in part at least, the competition of the electric roads.

The electric railroad has many things to its credit, but, nevertheless, it should also receive the credit for this new departure in railway work, for there is no doubt that the motor-car service referred to would not have been introduced, at least for some time yet, were it not for the necessity of offsetting in some way the inroads which competing electric roads are making in the passenger traffic of the steam lines. The electric system not only provides additional means of traveling, but is forcing the steam lines to give a better service than they maintained before.

The Design of a 1,500 to 3,000-Kilowatt Steam-Electric Central Light and Power Plant.[1]—III.

(Concluded.)

By Frank Koester.

STEAM PIPING.

IN order to draw either saturated or superheated steam from the boiler the cross-pieces from the two drums of each boiler are connected to the nozzle of the superheater, by means of two angle globe valves and a T fitting, as will be seen in the cross section (Fig. 3) of the plant. As the pipes lead to one common header and as the pressure from one boiler may easily vary, a non-return angle-valve is directly mounted on the above-mentioned T. From here a four-inch pipe leads to the header, which is seven inches in diameter. It would have been an easy matter to have brought the pipes from the header through the division wall directly to the throttles of the turbines nearest the boiler room, while in carrying over to the other turbines in this manner difficulty would have been experienced in supporting and draining the pipes, and it would certainly not have improved the appearance of the plant. The writer therefore decided to bring two seven-inch steam down-takes below the main operating room floor, connecting them together here, by means of a short header, in order to form a complete ring. From this lower section, as will be seen in the pipe drawing (Fig. 4), as well as in the cross section (Fig. 3), five-inch pipes run below the generating room floor, rising through it to the turbines. A similar arrangement has been made for the exciter units. The auxiliary machinery, such as the circulating water pumps, house pumps and hot-well pumps, draw their steam from the main steam pipe leading to its turbine. These pumps operate under the same steam conditions as the turbines, while the boiler feed pumps and the two small house pumps are operated also from steam of the same character, except that this steam will contain a small amount of water which has been collected from the entire pipe system, the steam for these pumps being drawn from the bottom of the lowest main header and the piping therefore acting at the same time as a drip system. There are no further traps or similar features for draining the remainder of the system. The reason for this is that, first, the steam does not contain much water, which would not interfere with the operation of pumps of this character, and, second, one does away with the trap system, which is liable to leak large quantities of steam after a short time in service. It will be seen in the accompanying piping sketch (Fig. 4) that the upper header does not have any drip pipe at all and the small amount of condensation will run down into the lower header, where all T's and outside ends of valves are connected by a three-fourths-inch globe valve and an additional check-valve to a short one-and-one-half-inch header from where the pipe leads to the above-mentioned pumps.

In order to secure a proper operation and so that any section of the pipe may be easily cut off in case of an emergency, non-return valves must be placed near the boiler. The four-inch pipes leading from the boilers to the header may be cut off at the header by gate-valves, while in the header itself, at the junction of boiler No. 4 and boiler No. 5, are inserted two seven-inch gate-valves. One valve would have been sufficient were it not for the condensation in the pipe, as the latter dead section of pipe is forty-five feet long and under ordinary operating conditions does not carry any steam. On each end of the steam down-takes valves are also placed. Besides this there are valves inserted at the branches leading to the turbine and exciter engines in order to cut out any section of the pipe in case of emergency. The supply pipes to the turbines have additional gate-valves close to the units, controlled by stands on the operating room floor.

The upper as well as the lower header pipes are well anchored on the crane and building columns, and has been indicated on the plan (Fig. 2), as well as in the pipe drawing (Fig. 4). This has been done, first, on account of vibration, and, second, on account of expansion. As the anchors are located in the middle of the piping, the expansion has to extend toward both ends. The expansion of one side (sixty feet) will be approximately two inches and will be easily taken up by the four-inch pipes leading from the boilers to the header, while the expansion of each half of the lower header, each of which has a length of about thirty-five feet, 1.2 inches, is taken up by the steam down-takes, which are some twenty-three feet long. It will therefore be seen that no expansion loops are necessary. The lower steam header, as well as the pipes leading to the turbines, are carried from the floor beams above, while the upper steam header is easily suspended from the steel structure carrying the smoke-flue. A platform will be erected directly beneath the latter header in order to give easy access to the various valves. This platform will be carried by the division wall at one end and the

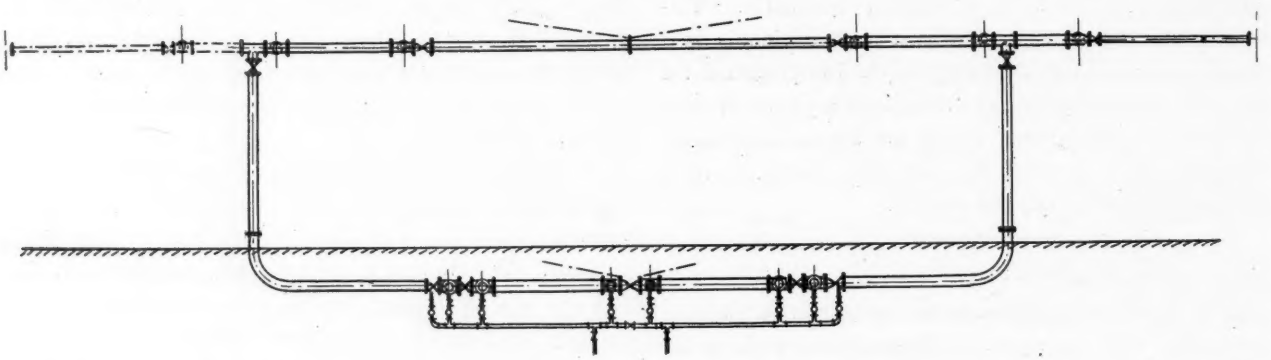


FIG. 4.—STEAM PIPING SYSTEM, 1,500-3,000-KILOWATT STEAM-ELECTRIC CENTRAL LIGHT AND POWER PLANT.

[1] Copyright, 1907, by Frank Koester.

beams from which the boilers are suspended, at the other end.

Returning to the size of steam pipes, the following data was employed in the calculations, as the manufacturers guarantee a steam consumption not to exceed seventeen pounds per kilowatt-hour, normal load for rated capacity, and as approximately ten per cent of the total steam consumption is used for auxiliaries, etc., the twenty pounds assumed in the beginning of the article is a safe assumption. As the volume of dry saturated steam at 175 pounds pressure is 2.4 cubic feet per pound, the total volume of steam per turbine per hour would be 275 by 17 by 2.4 = 11,220 cubic feet, giving a velocity, in a five-inch pipe, of 7,000 feet per minute. Under ordinary operating conditions dry saturated steam is not used, but steam superheated about 150 degrees Fahrenheit, which increases the volume approximately thirty-one per cent, thus giving a lineal velocity in the same size pipe of 9,100 feet per minute.

Even though there is considerable difficulty at times in securing fittings for five-inch piping (the greater bulk of pipe being steel), it would be poor practice to use one size larger (six inches), as the velocity would be only 6,500 feet for superheated steam, while the velocity in a four-inch pipe would be too great for American practice, although frequently used on the Continent, where higher degrees of superheat are common practice. For the same reasons, and taking well into consideration the steam consumption of the auxiliaries, four inches was chosen as the size of pipe from the boilers to the header.

As four four-inch pipes are approximately equivalent in carrying capacity to one seven-inch pipe, a seven-inch pipe is therefore chosen for the header or ring system.

The pipes will be covered with a thin layer of asbestos cement upon which is laid eighty-five per cent magnesia sectional covering, held together with galvanized iron wire netting. Over this an eight-ounce canvas covering is securely sewed and finally painted with fireproof paint.

TURBINES AND GENERATORS.

The turbines will be of the horizontal type, connected direct to the generators and both mounted on a common bed-plate. They are arranged, as will be seen in the plan (Fig. 2), two side by side, with steam ends toward the middle of the room. The steam connections are five-inch, each turbine is provided with a screen and throttling valve. After the steam has passed through the turbine it exhausts into the condenser through a twenty-four-inch outlet.

On account of the small weight of the turbo-generator and as much space is required in the basement for condensers and their auxiliary machinery, these turbines are carried in pairs on eighteen-inch beams, which in turn are supported on two concrete walls, thus giving ample space between and around the condensers and securing as easy a pipe arrangement as possible.

Pressure oil to the bearings of the turbines is supplied by a small pump operated from the main shaft of the turbine and mounted on the main bed-plate. After the oil has passed through the bearings, it is returned to a cooling and filtering system and used over again. The turbo-generator has a normal capacity of 750 kilowatts and has an overload capacity of fifty per cent; it is of the revolving-field, alternating-current type, and at 1,800 revolutions per minute has 7,200 alternations per minute (four poles), thus giving sixty cycles per second, suitable for lighting, power and railway service—for which purpose this plant has been designed. The voltage is 2,300. Due to the high velocity of these turbines, a "closed" type of generator is employed on account of the otherwise very objectionable noise. This necessitates a ventilating system which is obtained by bringing a fresh-air duct in under the main operating room floor to a point directly below the generator and discharging up through the bed-plate. Air is drawn from the area at the side of the building, the duct being turned downward and protected with a netting so as to prevent the entrance of any foreign substances.

CONDENSING PLANT.

The arrangement of the condensing plant depends upon the arrangement of the turbines, as the former is placed directly below the latter. Each condenser is supported on two I-beams, in turn supported by the small concrete piers and the turbine foundations. The exhaust of the turbine is so arranged as to discharge into the condenser or to the atmosphere. For this purpose an atmospheric relief-valve is placed in the exhaust pipe as near to the turbine exhaust outlet as possible. A gate-valve is placed between the free exhaust and the condenser, so that in case of repairs to the latter or its auxiliaries the turbine may be operated and exhaust direct to the atmosphere. Particular pains must be taken to avoid any leakage on pipes under vacuum, as this will materially affect the latter. A corrugated copper expansion joint is therefore placed between the turbine and condenser, as will be seen in the cross section (Fig. 3), to take up the expansion, which amounts to

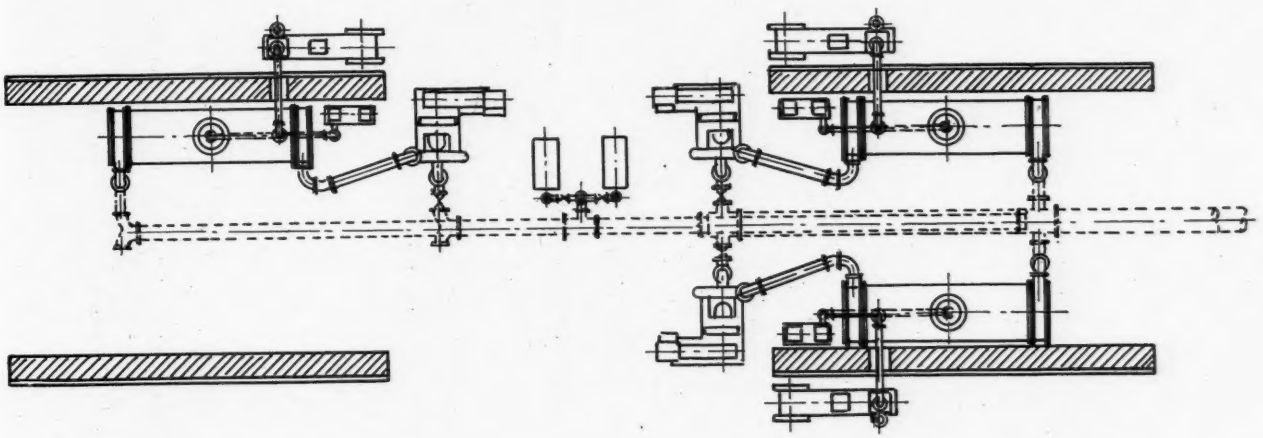


FIG. 5.—LAYOUT OF CONDENSER PLANT, 1,500-3,000 KILOWATT STEAM-ELECTRIC CENTRAL LIGHT AND POWER PLANT.

about one-eighth inch. The exhaust inlet to the condenser is twenty-four inches in diameter, while the free exhaust pipe from each turbine is fourteen inches. The latter size has been chosen to obtain a steam velocity of 5,000 feet per minute. All exhaust piping up to the atmospheric relief-valve is of cast iron; the flanges, after being carefully bolted together, are painted with shellac or asphaltum, while the rest of the exhaust piping, with the exception of a few fittings, are made of spiral riveted pipe. As will be seen in the plan (Fig. 2), the two fourteen-inch pipes of the two turbines are connected to one pipe twenty inches in diameter, leading into a twenty-inch riser terminating a few feet above the roof in an exhaust head. This arrangement allows two turbines to discharge at the same time to the atmosphere, while, under very unfavorable conditions, all three turbines may do the same.

It is common practice to allow four square feet cooling surface per kilowatt of turbine capacity, thus giving 3,000 feet for the surface condensers. This apparently large surface is chosen, as at times muddy or comparatively warm water is supplied. Under the above conditions and in order to obtain from twenty-eight to twenty-nine-inch vacuum (barometric reading thirty inches), the liable figure of seventy pounds of water to condense one pound of steam will be assumed, and figuring the velocity in the centrifugal pump at 450 feet per minute, a ten-inch pump will be required. As there will be, when the plant is completed, four condenser outfits, and as the velocity in the main circulating water intake has to be about 300 feet per minute, a twenty-inch pipe will be required. In order to have more uniformity in the size of pipes, the circulating water discharge pipe will be the same size. Both pipes, after supplying the first two condenser units, are reduced to sixteen inches. It will be noticed in the accompanying condenser plan (Fig. 5) that two small house pumps also draw their water from this pipe-line. The duty of these pumps, as has already been touched upon, is to make up the water lost by leakage at the boiler, consumption of the auxiliary machinery, etc. These pumps are six inches by four inches by six inches and have three-inch suction and two-and-one-half-inch discharge pipes. The circulating pumps, having a ten-inch suction and discharge, are operated by a single-cylinder horizontal engine (ten inches by ten inches), and as the velocity of the circulating water to the condenser has to be reduced, the pipe leading to the latter is twelve inches in diameter. The steam supply pipe to this engine is two and one-half inches and the exhaust three inches.

The exhaust steam enters the condenser at the top, and as the condenser is of the counter-current type, the cooling water enters at the bottom and is discharged at the top, where a twelve-inch connection is made to the main discharge pipe, located below the intake pipe in the trench, and emptying into the river. After the pumps have been started a syphon is formed and the pumps are required to overcome friction only. Both intake and discharge pipes are made of cast iron and outside of the power-house are imbedded in the earth. The intake pipe must be provided with a screen and a foot-valve. The circulating water pumps will be primed by means of the air or dry vacuum pumps.

These latter pumps are located outside of the turbine foundations, as will be seen in the condenser plan (Fig. 5). The air-pumps are connected to the condenser by means of a four-inch pipe and discharge through a three-and-one-half-inch pipe into the main atmospheric exhaust pipe. A dry vacuum pump six inches by fourteen inches by ten inches will be required, the steam connection being one and one-quarter inches and the exhaust one and one-half inches.

On the bottom of the condenser is a hot-well, where the condensed steam is collected. From here the water is drawn away through a three-inch suction pipe by means of a duplex pump (five inches by four and one-half inches by five inches) and discharged through a two-inch pipe into the make-up tank. These pumps start automatically by means of a regulator in the hot-well.

EXCITERS AND AIR-COMPRESSOR.

To secure a continuous operation of the plant two exciter units are necessary, one of which is always kept in reserve. As the ultimate total capacity of the plant is 3,000 kilowatts, one per cent, or thirty kilowatts, will be the required capacity of each exciter, this taking into consideration the fact that the latter can not be overloaded to the same extent as the main units. As practically all the auxiliary machinery is steam driven, the exciters are operated by eight-inch by eight-inch horizontal engines, the steam connection being two and one-half inches and the exhaust three inches.

For the purpose of blowing out the generators and switchboard apparatus, an air-compressor is installed at one side in the switching room. This is driven by means of a chain from a five-horse-power motor mounted on the frame of the compressor.

SWITCHBOARD AND WIRING SYSTEM.

As already stated, the switchboard is located in the middle of the generating room on the side wall. The generator feeders run under the floor direct to the oil switches, which are suspended from the generating room floor, from where they lead through one main slot to the rear of the switchboard. The switchboard itself is made of marbleized slate mounted on a steel frame. There are four generator panels, each twenty-four inches wide, two exciter panels, each sixteen inches wide, and eight feeder panels for lighting and power, also each sixteen inches in width, and one panel for the sectionalizing switches, this latter being thirty-two inches wide. This gives a total length of switchboard of about twenty-five feet.

In order to secure a flexible system and at the same time insure continuity of service and proper protection for the entire equipment, the following apparatus is mounted on the various panels. Three of the generating panels, the fourth being left blank for a future unit, each contain three ammeters for reading the current in each phase, one wattmeter, one field ammeter, and one power-factor indicator; these six meters being arranged in two vertical rows on the upper part of the panel. A recording wattmeter is mounted for convenience on the back of the board. Below the above-mentioned meters on the front of the board are symmetrically arranged one field switch, one potential receptacle and plug, one synchronizing receptacle and plug, one three-pole, double-throw oil switch operated by hand, and one rheostat wheel. The generator panels are mounted at one end of the board and on the outside panel is placed a swinging bracket containing one wattmeter, one synchroscope, and two synchronizing lamps. Adjoining the generator panels are the two exciter panels, each containing a voltmeter, ammeter, rheostat wheel and a two-pole, single-throw knife switch, the equalizing switches being mounted directly at the machines.

Upon each panel for the outgoing feeders is mounted a three-pole, single-throw oil switch in order to draw current from either of the two sets of buses, and an ammeter and voltmeter, a wattmeter being unnecessary, as the power may be measured at the substation.

A special lighting panel will be installed

at the side of the office in the switching room, as shown in Fig. 2. This panel will be thirty-two inches wide, with the following mounted on the front: one double-pole knife switch for each lighting circuit and one double-pole, double-throw knife switch so that the lighting buses may be thrown on to the exciter buses or on to the secondary of a special lighting transformer. Near this transformer is mounted its oil switch. There is also a small three-phase transformer for supplying power to the coal conveyer and air-compressor motors with the main oil switch mounted at the transformer and local knife switches mounted at each motor.

The accompanying diagram (Fig. 6) shows the main features of the wiring diagram, small details, such as the location of meters, etc., being omitted. It will be seen that the bus-bars are cut up by means of sectionalizing switches at four different places, one being between the outside generators and two being between generators No. 2 and No. 3. This latter precaution has been taken in order that interruption of the lighting and motor circuits may be reduced to a minimum. It will be seen from the diagram that the entire system is laid out as symmetrically as possible, and sufficient switches have been placed so as to make the system as flexible as possible, and in order to meet any emergency which may arise in the plant itself or in the outgoing feeders.

The double bus-bar system has been adopted for the same reason as the ring system in the steam piping. Both the wiring and piping systems are the main arteries in their respective departments, upon which depends largely the effective and continuous operation of the plant. Current may be thrown into either of the two buses or on both at the same time, and the outgoing feeders may draw from one or both sets. One bus-bar system may serve exclusively for light and the other for power, the outgoing feeders leading underground to the various substations where the current is transformed to voltages suitable for either light or power.

CONCLUSION.

To give an exact figure of the cost of this plant is impossible, as it depends so largely upon the location. As this plant has been designed with the best possible equipment, using all first-class material and with the point in view of reducing the working force to a minimum, assuming that the site is convenient for securing labor and shipping facilities, the price of the plant, with the complete ultimate equipment (3,000 kilowatts), would approximate $390,000, or $130 per kilowatt normal rating. This figure is the result of a comparison of the actual costs of a number of similar plants which have come either directly or indirectly under the writer's charge. Increased size and capacity of a plant may reduce the first cost to about $100 per kilowatt, depending, of course, as stated, upon the size of the plant. Another alternative for reducing the cost of the plant, which unfortunately is too frequently adopted, is to simplify the general layout. Such plants are built for the purpose of putting them in operation as soon as possible, securing a large number of customers and selling the plant with a large profit, regardless of operating economies. For following this scheme the writer would suggest the following simplifications, and by adopting these the plant may still be run satisfactorily, but the number of employés and operating expenses will be increased, while the first cost will be decreased some $50,000 or $60,000, making about $110 per kilowatt: Do away with boiler-room basement, suspended coal bunkers and suspended ash hopper, coal and ash handling conveyer system, mechanical stokers, and also the track scale for weighing the incoming coal. The coal cars may be brought on a trestle higher than shown in the cross-section, so that the coal may drop from the car and slide through an opening to the boiler-room floor or be shoveled on to it. The ashes will be carted away from the main operating-room floor. With this arrangement the height of the boiler room will be decreased twenty feet. At the same time the generating-room basement and area-way at the side of the building may be omitted, in which case the turbines

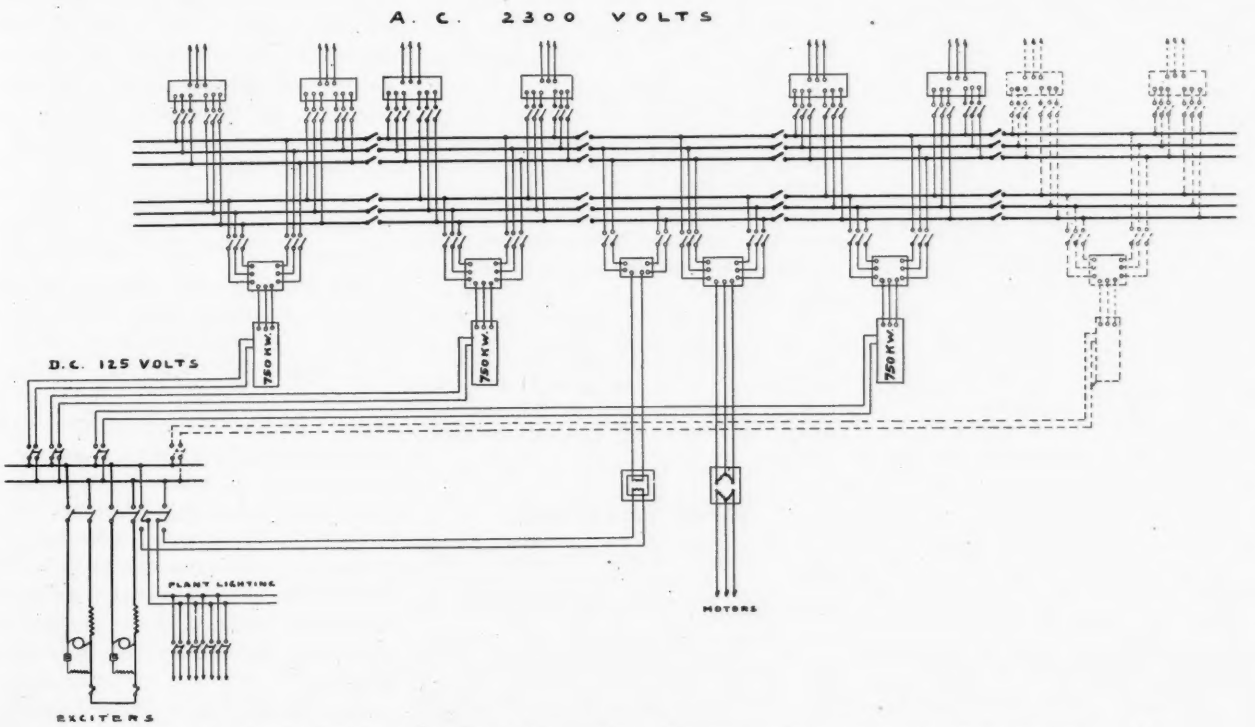


FIG. 6.—WIRING SYSTEM, 1,500-3,000 KILOWATT STEAM-ELECTRIC CENTRAL LIGHT AND POWER PLANT.

would be installed on frameworks built up so as to leave space for the condensers, etc., underneath, and small pits dug so as to accommodate the hot-well pumps.

The pipes, such as mains, steam, exhaust, blow-off, etc., will be placed in trenches. The piping system may be simplified by omitting some of the valves, and also the provision for drawing either superheated or saturated steam. In fact, the superheaters themselves may be omitted. Another saving could be effected by simplifying the bus-bar system, using a single instead of a double system. As the space in the basement used for switching purposes, repair, store, locker rooms, etc., has been done away with, a two-story compartment will be required for this purpose. The second story, of course, will be installed directly above the main switchboard, and over the entire length of the generating room. From the total height of the generating room thirteen feet will be saved.

Instead of the generating-room floor being tiled, it may receive a granolythic cement finish. Also the tiled wainscoting around the room may be omitted.

Of course, a case might arise where the installation of condensers and their auxiliaries would be unadvisable, depending upon the character of the water supply. Before laying out the plant a close study of this feature should be made.

A still further decrease in first cost could be obtained by doing away with the steel columns and having only the roof trusses of steel, the wall being of brick instead of reinforced concrete, the crane runway resting on brick pilasters.

If the plant were to be built on the Continent, where the operating conditions are considered of greater importance, and where still better results are desired than those obtainable with the original equipment, the following design would have been adopted:

No stokers would have been installed, as labor is easily obtainable so skilled as to produce one horse-power hour for one and a quarter pounds of coal at 12,000 British thermal units per pound. The turbines are sold with the guarantee that the steam consumption will not exceed nine and a half to ten pounds per indicated horse-power hour when using a high degree of superheat at 175 to 200 pounds pressure and a vacuum of not less than twenty-seven inches, and everyday practice proves that these guarantees are strictly lived up to. Superheaters will be installed capable of furnishing steam at a total temperature of 700 degrees to 750 degrees Fahrenheit, which would not cause any extra deterioration in the turbine. All auxiliary machinery will be motor-driven, and a small storage battery will be installed for supplying light for the station and exciter current in case of emergency. As, however, warm water is required for boiler feed, economizers will be installed in the basement, where also the smoke-flue will be arranged. Smoke-flue and chimney will both be built of brick.

Owing to the higher temperature of the steam a greater velocity will be secured, and the size of pipes will be decreased. The wiring system will be a more complicated one.

Assuming that the total water consumption of this plant, including auxiliaries, leakage, etc., is seventeen pounds per kilowatt-hour, a very unfavorable figure under Continental conditions, and the water consumption for the above-designed plant of twenty pounds per kilowatt-hour, there will be a saving of three pounds effected. On account of the fact that the plant is for both lighting and railroad purposes, and will, therefore, have a widely-fluctuating load, we will assume that the total daily output of the 3,000-kilowatt station is only 30,000 kilowatt hours. Assuming further that one pound of coal evaporates eight pounds of water, and that the coal costs $2.50 per ton, a saving of $4,180 will be effected per year. This is a net saving of fifteen per cent of the total coal consumption.

BOOK REVIEWS.

"Boiler Waters, Scale, Corrosion, Foaming." William Wallace Christie. New York. D. Van Nostrand Company. 6¼ by 9¼ inches. 235 pages. Cloth. Supplied by the ELECTRICAL REVIEW at $3.00.

The author clearly points out in the fore part of this work the value of using pure water in a boiler. Corrosion and boiler scale are well treated, and instructively illustrated by photographs of samples taken from various boilers in various parts of the country. The prevention of boiler corrosion and scaling is ably discussed. A chapter on foaming describes the various methods of freeing the feed-water of oil. A very valuable article is that on feed-water heaters, both of the open and closed type. The latter are of especial interest. But little information is given in the article on economizers, only one make being discussed. Water purifiers are treated at length but not completely; many valuable and interesting illustrations are contained in this chapter and some useful tables are given in the concluding one.

The book, taken as a whole, is a good one and fills a long-felt want. It is truly a "pioneer on this subject in this country," as announced by the author, and might well be adopted by every user of steam; for, if its dictates are intelligently followed, considerable cost of repairs will be obviated, as to-day very little attention is given to softening feed-water and removing the impurities.

"Alternating-Current Motors." A. S. McAllister. New York. McGraw Publishing Company. Cloth. 278 pages. 6¼ by 9½ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $3.00.

It is pleasing to note that the author starts directly at his subject without the discussion of electrical units and elementary theory with which so many authors begin books on similar subjects. The first chapter deals with the properties of single and polyphase circuits and the measurement of power in them. The nine following chapters take up the characteristics of the various forms of induction motors, induction generators and induction frequency changers. The treatment of the Heyland motor is especially good in that it starts with the plain induction motor at standstill with the secondary excited at full frequency, then takes up the same motor at synchronism with direct-current secondary excitation and shows how Heyland obtains an intermediate condition by means of a commutator. The treatment of the single-phase induction motor is also good. The eleventh chapter gives some of the fundamentals of synchronous motors and converters. Chapter twelve is a general discussion of electromagnetic torque. Chapters thirteen and fourteen deal with the plain and compensated repulsion motor. The plain and compensated series motors are discussed in chapter fifteen.

The subject of prevention of sparking in single-phase commutators is fully discussed in chapter sixteen.

The general method of treating all motors is first to outline the theory roughly, leaving out the less important factors and then to go through again putting in the details. All of the motors are treated both algebraically and graphically, with considerable stress on the graphical method. In the algebraic treatment, complex quantities have not been used. The relation between the different chapters on the induction motor is not clear in some cases, as practically the same ground is covered by a number of them. This is probably due to the fact stated in the preface that some of the matter was written as articles for the technical press. While the book is rather abstract, still it gives a good general idea of the characteristics of the different motors.

A NEW TYPE OF INDUCTION MOTOR.[1]

BY LOUIS J. HUNT, A.M.I.E.E.

The motor described in this paper possesses all the characteristics of the ordinary type of slip ring induction motor, but differs from it in the arrangement of the windings. These are arranged to permit of the starting or regulating resistances being connected to the stator windings instead of to slip rings in the ordinary manner. The machine is an improved form of "cascade" motor, having two magnetic field systems superimposed upon one another in the same core body. The second field has its origin in the rotor, and consequently induces secondary currents in the stator windings.

Machines of this type may be roughly

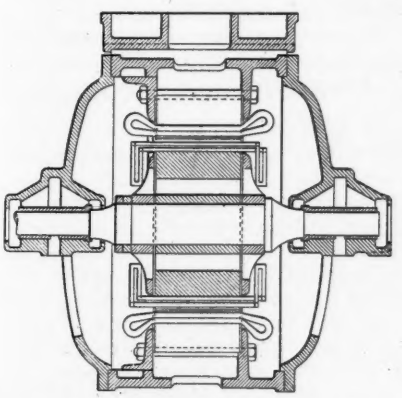


FIG. 1.—GENERAL ARRANGEMENT OF MOTOR.

divided into two groups, the first including motors depending upon suitable spacing of the stator windings to insure non-interlinking of the two fields, and the second including machines provided with two stator windings wound for dissimilar numbers of poles.

The new motor belongs to the second group, the two numbers of poles being so chosen that when divided by their greatest common factor the quotient is in one case an even and in the other an odd number. This insures non-interlinking of the two windings except by the agency of the rotor.

Fig. 1 shows the general arrangement of this motor, from which it will be seen that it closely resembles in design the ordinary type of machine.

The stator carries a single winding, and is provided with terminals for connecting to the supply mains, and with tappings which are connected in pairs through resistances whilst starting or when rheostatic speed control is desired, and are short-circuited at normal speed. The rotor is provided with a short-circuited winding without slip rings, unless designed to run at more than one efficient speed.

The chief difficulties to be overcome in the design of a "cascade" motor are greatly increased magnetic leakage and I^2R

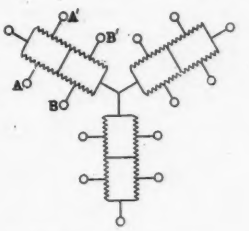


FIG. 2.—THREE-PHASE PRIMARY, SIX-PHASE SECONDARY STATOR WINDING.

losses. Where two stator windings are used the inductance of the one occupying that portion of the slots farthest removed from the rotor is very large, owing to the increased leakage from tooth to tooth.

In experiments, which were made on a motor wound with separate eight-pole and four-pole stator windings, the former being placed nearest to the rotor, it was found that the leakage per ampere-turn, per inch length of core (after deducting the leakage of the end connections) was 7 in the case of the eight-pole winding and 11.4 in the case of the four-pole winding. The pole pitch of the four-pole winding was, of course, twice that of the eight-pole, and if the conductors had occupied the position of the eight-pole winding the leakage would have been certainly not more than six lines. By using one stator winding only, this difficulty was overcome, and experiments on the same motor showed that the power-factor and overload capacity were much increased, although only two-thirds of the

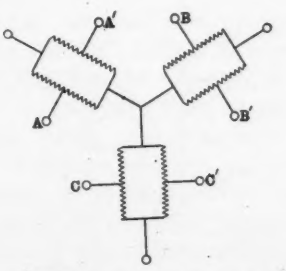


FIG. 3.—STATOR WINDING TAPPED FOR SECONDARY CURRENT.

copper was used. The stator windings are parallel wound, and each pair of tappings connects two points of the winding between which there is no "primary" difference of potential. Fig. 2 shows diagrammatically a three-phase primary, six-phase secondary stator winding.

The mains are coupled to the three terminals of the "star," and the starting resistances, arranged for two-phase currents, are connected to the tappings A, A' and B, B'. The remaining tappings are connected to a four-pole switch mounted on the motor casing, and are short-circuited after the machine has reached its normal speed. This winding, although involving the use of a short-circuiting switch, is preferred for constant speed motors, as the magnetic leakage and I^2R losses are rather less than would be the case if the windings were tapped for three-phase currents only. The currents in each branch are in quadrature. The resultant stator current is equal to the geometrical sum of the primary and secondary currents, and may be anything in value between 1.07 and 1.2 times the primary current. The arrangement of the windings and the power-factor of the motor determine the actual value of the current.

For motors designed for variable speed work, with rheostatic control, it is prefer-

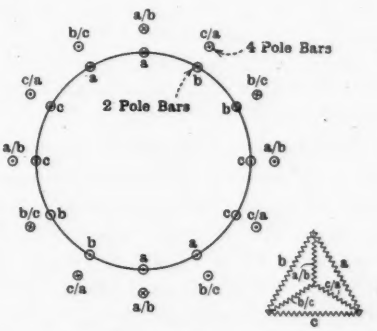


FIG. 4.—ROTOR WITH TWO WINDINGS, ONE CONNECTED FOR TWO POLES, THE OTHER FOR FOUR POLES.

able to tap the stator windings for two or three-phase secondary currents in order that the whole of the windings may be active during the time when the tappings are not short-circuited. Fig. 3 shows diagramatically a suitable winding for this purpose. The tappings A, A'; B, B'; C, C' are connected to three independent resistances.

Referring now to the rotor, a large number of different methods of winding are possible. It is important to keep the rotor I^2R losses as small as possible in order to insure a high efficiency, and also to reduce the drop in voltage between the primary and secondary parts of the machine. The voltage drop has an important bearing on the performance of the motor as, omitting consideration of the induct-

[1] Condensed from a paper read before the Manchester section of the Institution of Electrical Engineers of Great Britain, March 19.

ance, the magnitude of the second flux depends upon it. If the IR drop be large, the overload capacity will be prejudicially affected.

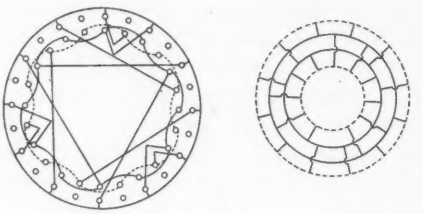
The rotor may be provided with two separate windings, one wound for x number of poles and the other for y number of poles, the two being inter-connected. In this case the currents induced in the x pole winding flow into the y pole conductors, and produce the second magnetic field. The objection raised to the two separate stator windings does not apply to the rotor, as the frequency of the currents is the same in both rotor windings. In fact, the local leakage lines are due to the resultants of the currents in the two sets of conductors, and by suitable arrangement the total inductance of the two windings may be made less than the sum of the inductances considered separately. Fig. 4 shows a rotor having two windings, one connected for four poles and the other for two poles. The former is "star" and the latter "mesh" connected. The four-pole ampere-turns are consequently equal to 1.73 times the two-pole ampere-turns. Only one slot per pole per phase is shown in the diagram.

Instead of grouping the bars in two separate three-phase windings, the four-pole and two-pole conductors may be connected to form a winding, as shown in Fig. 5.

This arrangement reduces the length of copper required in the end connections, and has the same effect as two separate windings. The two-pole bars are connected to form two "mesh" windings, as shown. Each four-pole bar is connected at one end to a two-pole bar, and at the other to a short-circuiting ring. There are two of these rings, one at each end of the rotor. Only the connections at one end of the rotor are shown. Those at the opposite end are duplicates of these. The outside circle represents one of the short-circuiting rings. The inner ring of small circles are the two-pole bars, the outer ring the four-pole conductors. Fig. 6 shows this winding diagramatically. The dotted circles are the short-circuiting rings and the full-line ones the "mesh" connected two-pole conductors. Each radial line represents a four-pole bar.

A $(4+2)$ pole winding has been shown, but it may be mentioned that as the resultant magnetic field is not symmetrical, a motor having this number of poles is not satisfactory. If, however, diagrams had been prepared for a larger number of poles they would have been confusing when reduced to a small scale.

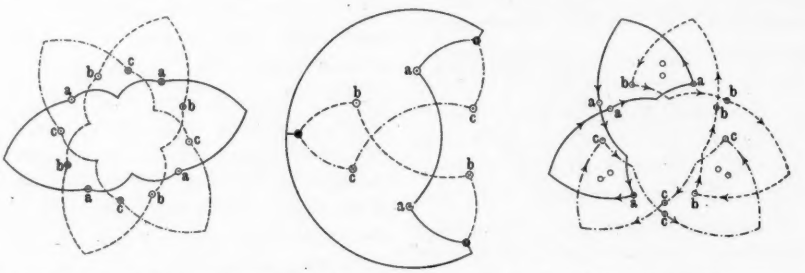
The currents of the two rotor-windings in any one slot may be algebraically added together and considered as one current. By a suitable arrangement of the connections one winding may therefore be substituted for the two, and the total C^2R losses reduced to that of the x pole winding only. Figs. 7 and 8 show the direc-



FIGS. 5 AND 6.—SPECIAL WINDINGS.

tions of the currents in four-pole and two-pole windings at the instant when the current in the a phase is equal to m, and those in the b and c phases to $\frac{m}{2}$. Two-pole bars occupy only one-half of the slots.

By super-imposing one diagram upon the other it will be seen that some of the currents cancel one another. The resultant diagram is shown in Fig. 9.



FIGS. 7, 8 AND 9.—DIRECTION OF CURRENTS IN FOUR-POLE AND TWO-POLE WINDINGS AND RESULTANT DIAGRAM, RESPECTIVELY.

The number of conductors and the total length of the end connections are equal to those of the four-pole winding only. On the score of low copper loss this is a very good winding, but it has two serious faults; the slots are deep owing to the concentration of the conductors, and the inductance, for the same reason, is considerably higher than that of the windings already described. Experiments were made with a small twelve-pole motor, the rotor of which was provided with double windings similar to those shown in Fig. 4. After tests had been made, it was rewound with a single winding as shown in Fig. 5. The double winding gave a power-factor of 0.78 and the single winding 0.72. These results were obtained with a double-wound stator. The eight-pole stator winding was then reconnected and provided with six-phase tappings, and further tests showed a rise in power-factor from 0.78 to 0.81. The efficiency was, of course, higher with the single than with the double rotor winding. One may extend the list of resultant windings indefinitely.

The rotor windings already described are suitable for motors having one efficient speed. Motors are being manufactured which may run at two, three, or four efficient speeds, and it is clear that as these require the addition of slip rings, the number of phases for which the rotors may be wound must be limited to two or three.

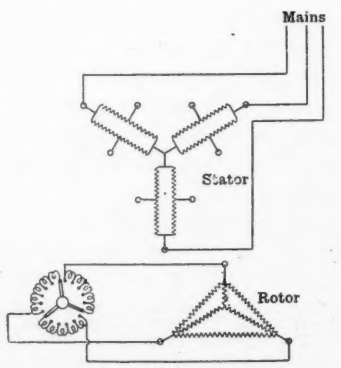


FIG. 10.—STATOR AND ROTOR WINDINGS FOR "STAR" AND "MESH" CONNECTIONS.

A twelve-pole motor having a rotor carrying eight-pole and four-pole windings may, if fitted with three slip rings, be run at speeds corresponding to twelve, eight, or four poles without losses in resistances. For a two-speed motor the connections are very simple, and especially is this the case if two rheostats are used. Fig 10 shows diagramatically the stator and rotor windings where the latter are of the type shown in Fig. 4.

If the motor be wound for eight and four poles and the periodicity be fifty cycles per second, the two efficient synchronous speeds will be 500 and 750 revolutions per minute. The "mesh" connected rotor windings are wound for four poles and the "star" windings for eight poles. Slip rings are connected to the three terminals shown. The three stator terminals are

connected to the mains, and the tappings are coupled in pairs by three resistances. As these resistances are cut out of circuit the motor speeds up until, with the tappings short-circuited, it reaches a speed approximating to 500 revolutions per minute. The three slip rings are now connected through resistances, and as these are cut out of circuit the motor speed increases until it reaches 750 revolutions per minute, with the rings short-circuited. No current now flows through the stator tappings or into the four-pole rotor winding. The motor will give an increased output, as the iron losses are less than when cascade-connected, and the copper losses are also much reduced.

In order to obtain three effective speeds a change-over switch is necessary in the stator circuit. This enables the connections to be changed so that the primary currents may produce either an eight-pole or a four-pole magnetic field. When connected for four poles, and with the slip rings short-circuited, the motor runs at a speed of 1,500 revolutions per minute. The eight-pole rotor winding is now inoperative.

By the use of five slip rings, the rotor connections may be changed so that both magnetic fields rotate in the same direction. The motor then runs at a speed corresponding to that of a machine wound for a number of poles equal to the difference between the number of poles of the two magnetic fields. For example, if the motor be wound for twelve and eight poles, and used on a 50-cycle circuit, the following speeds can be obtained: 300, 500, 750 and 1,500 revolutions per minute.

If continuous, as well as alternating currents, be supplied to the stator windings, the motor runs at synchronous speed. The continuous-current leads may be taken to the tappings of one of the phases of the winding, or a parallel star winding may be used. In the latter case the continuous-current leads would be connected to the two neutral points of the "stars." The machine is started up as an induction motor, and when it has reached normal speed the continuous-current switch is closed. The motor pulls into step, no synchronizing gear being necessary. There is no difficulty in starting against load.

Electric Cars for Bahia.

Arrangements have been made for the construction by the Bahia Tramway, Light and Power Company, which was recently incorporated in Maine with a capital of $3,500,000, of a street railway system in Bahia, one of the principal cities of Brazil. It is estimated that the cost of carrying out the plan will be $10,000,000. In addition to the stock issue the stockholders have authorized an issue of $7,500,000 fifty-year five per cent first mortgage bonds, of which about half has been offered in London and Brussels at 90½. The company has acquired control of two electrical companies now operating in Bahia. Interested in the enterprise are Percival Farquhar, W. L. Bull and F. S. Pearson, 25 Broad street, New York city.

THE STERILIZATION AND PRESERVATION OF TELEPHONE AND TELEGRAPH POLES.[1]

BY H. P. FOLSOM.

The importance of this subject will be appreciated when we say there are about 250,000 miles of telegraph pole lines and about 500,000 miles of telephone lines in the United States, making a total of 750,000 miles of pole line. It is safe to say that these lines average thirty-seven poles per mile, thus making 27,750,000. The poles used for electric railroads and electric light plants will make an addition to this amount of 5,000,000, or a grand total of 32,750,000 poles, according to Government report for 1902. There are now 40,000,000 poles in use by all companies. The value of these poles placed in the ground ready for use will average more than $5 a piece, or about $200,000,000. This vast amount of property is exposed to the weather and is constantly deteriorating and decaying; this deterioration and decay goes on day and night and is as certain to rot the pole down as death is certain to overtake man and cut him down.

The average life of a white cedar pole is said to be from twelve to fifteen years; it varies, however, according to its condition when placed in the ground and the nature of the soil and climate. All poles and posts rot off at or near the soil line. The decayed portion extends a few inches above and about three or four inches below the soil line, the depth below being governed largely by the nature of the soil surrounding the pole. The portion of the pole from the soil line to the top will last many years. Indeed, there is reason to believe that it will last three times as long as the portion that goes into the ground. Again, millions of poles are being used each year to replace the ones that have rotted off. The Bell company used over 500,000 poles in one year to replace old ones. Vast areas of forest are being denuded each year and poles are constantly growing scarcer as well as more expensive. Where the telephone and telegraph companies are going to get their poles in the next twelve to twenty years is indeed a problem worthy of the most careful consideration by all companies interested.

It has been proved beyond question that the decay which takes place at or near the soil line of the post or pole is caused primarily by living organisms, namely, bacteria or fungi, and in some rare instances by insects. Bacteria and fungi are both low forms of life; they multiply when once they attack a pole with great rapidity, and since their action on the fibre of the wood is practically the same, they will be considered in this paper together. They attack either dead or living timber; on dead timber they attack the walls of the cells and the result is the familiar decay or rot under consideration.

It has been observed that a line of poles running through a pasture field, where there is grass growing, will be more quickly attacked than in any other situation. Again, a line of poles situated on the north side of a hill will be more quickly attacked than on the south side, providing the soil is loose and porous. A pole under water will not be attacked by fungi and bacteria, neither will it when surrounded by soil containing certain chemicals. A few years ago it was thought by the telegraph and telephone companies that if the dirt was heaped up around the pole, thus leaving a certain amount of drainage away from it, no decay would take place at the soil line. Experience has shown that this was a mistake; the pole was attacked just the same, only a little higher.

It will be observed in passing that the great enemy of the telephone pole is the same that attacks the millions of railroad ties in use. The conditions surrounding a railroad tie are more favorable for the rapid growth of the bacteria and fungi than in the case of the pole. They lie flat on the ground, constantly absorbing moisture, and being exposed to the rays of the sun, have the two necessary conditions for rapid growth. The problem of protecting and sterilizing railroad ties is a much more difficult one than we have to contend with in the case of telephone poles, although it is generally supposed by experimenters that this is not the case.

We believe we have found a means to sterilize poles in the ground that is practical and certain, and that, too, at a cost which is reasonable and much less than the natural depreciation will amount to.

It having been demonstrated by a long line of experiments that the cause of decay at the ground line was a bacteria and fungus growth induced by a certain amount of moisture and heat from the sun, and that in order to sterilize and save the life of the pole, we must use an antiseptic that would penetrate the pores of the wood, we selected a class of poles that had been in the ground for about eight years, and which were thoroughly infested with germs; indeed, some of the poles upon which we experimented were

[1] Abstract of an address delivered at the Convention of the Ohio Independent Telephone Association, March 28, 1907.

over half rotted through and would not have lasted two years under the most favorable conditions; they were so weak that they would not have survived a severe storm at all. We dug down around the pole about eighteen inches and with a pointed instrument scraped out and away all the rotted wood. We then applied our antiseptic chemicals with a trowel, filling all the holes and depressions even with the surface of the pole. We next placed around the pole an especially constructed jacket made of pliable and especially prepared asbestos that would resist the action of the elements, such as rain, snow, freezing and thawing. We filled in around the poles the antiseptic material to the top of the jacket in the space between it and the pole. We allowed the top in some instances to remain open so that it received all the rain and snow that fell and which might run down the pole. In others we placed a cap over the top of the jacket. We were careful in mixing our antiseptics to use none that would cause the pole to become brittle and thus weaken it. We found that in all instances after a period of over six years our antiseptics had completely sterilized the poles where applied, and the decay was entirely arrested. In fact the poles were in as good condition as when the treatment was first applied. We carried our experiments further and treated a class of poles that had not been in the ground more than two or three years. The surface indications showed only slight infection, but the sappy portion had begun to scale and the cracks exhibited unmistakable signs of decay. We did not attempt to clean off the decayed portion of this class of poles, but treated them by placing the jacket around the pole and depositing between it and the jacket our antiseptics and then sealed and fastened the collar above referred to. The jacket on these poles was about eighteen inches wide, extending below the ground about fourteen inches, and above the ground about four inches. Upon examination of this class of poles nearly six years after treatment they were completely sterilized and free from the effects of the bacteria and fungi. There was no evidence of them under a powerful microscope.

We have made some figures based upon our experiments which show that the cost is within the reach of all companies and can easily be paid out of the depreciation account and still leave a handsome surplus.

Suppose we take a plant of 5,000 poles, costing $5 each, in the ground fully equipped.

It will be perceived that if the pole is preserved intact, with full strength for ten years by means of the jacket and chemicals, and it is removed or entirely gone at the end of that time, the pole will be in the same condition to resist the fungi that it was when first treated, and will have its original strength and life.

It will be observed that in our calculations we have not taken into account the increased amount of trouble that always accompanies the use of old poles the last few years of their lives. This item of the maintenance account always increases as the poles grow older and weaker, and should be placed on the credit side where our process is used. Then, again, in all human probability poles will be at least twenty-five per cent higher in value twelve years from this time. If that be the case, the cost of the new poles when they had to be renewed would be $6,750 more and the interest on this increased amount for twelve years would be $4,500, making $10,750 more to be added to the profits of sterilizing, or a total of $40,375 in twenty-four years.

Their original cost would be	$25,000
At the end of twelve years they will have to be renewed at cost of	25,000
Counting interest for twelve years on the last $25,000 equals	18,000
Making a total cost for twenty-four years of	$68,000
Suppose we take the same plant and apply the treatment.	
Original cost of 5,000 poles	$25,000
Cost of sterilizing after they have been in the ground two years, $1.25 each (and it can be done for less)	6,250
Interest on this amount for twenty-two years	8,250
Making a total cost for twenty-four years	$39,500
Cost for twenty-four years without treatment	$68,000
Cost for twenty-four years with treatment	39,500
Profit in favor of treatment	$28,500

The Strawberry Valley Tunnel Project.

Some very interesting engineering work is being prosecuted in connection with the reclamation service of the United States Coast and Geodetic Survey. One of the more recent of these undertakings has been inaugurated near Vernal, Utah, known as the "Strawberry Valley Project."

This project includes the irrigation of several thousand acres of productive soil in the southern part of Utah county. A storage dam, having a capacity of about 100,000 square feet, and reaching a height of forty-five feet, will be thrown across the Strawberry river. Water from this reservoir will be led through a tunnel more than three and one-half miles long to the distribution points, where it will be diverted into canals for irrigating the various ranches.

The construction of this dam will make possible the electrical development of a considerable water power, and a power-house having a capacity of 2,250 kilowatts is contemplated. The power will be used not only for lighting various surrounding small towns, but for motor-driven centrifugal irrigating pumps.

A temporary power-house will be erected at once at Spanish Fork, some thirty-three miles from the construction camp, so that electricity will be available for building operations. The electrical equipment will form the nucleus of the plant, which will eventually be installed on the Strawberry river.

The electrical equipment for this temporary power plant will be furnished by the General Electric Company, the initial apparatus including two 425-kilowatt, three-phase, alternating-current generators, direct connected to Leffel water-wheels. The generators will furnish current at a potential of 11,000 volts to step-up transformers, which in turn will raise the voltage to 22,000 for transmission. Two belt-driven, forty-five-kilowatt generators will supply direct current at a potential of 125 volts for excitation purposes. Switchboard equipment will be provided for both the main station and two substations.

At the substations motor-generator sets will be installed for supplying direct current for hoisting motors and other purposes. The motor-generator sets consist of seventy-five-kilowatt and fifty-kilowatt direct-current machines, each direct-connected respectively to a 175-horse-power and a 125-horse-power, 2,080-volt induction motor. The shafts on the induction motors are extended to take pulleys from which air-compressors are belt driven. The compressed air is used for driving rock drills. On account of the double duty which they perform, the induction motors are of the comparatively large capacity indicated.

Work on the tunnel has already started, but will be greatly facilitated when the temporary power-house is completed, since the operations up to the present have been handicapped by the employment of small gasolene engines for power.

American Institute of Electrical Engineers.

The 218th meeting of the American Institute of Electrical Engineers was held in New York city on April 26. This was a double-barreled meeting, the paper entitled "Light from Gaseous Conductors Within Glass Tubes—the Moore Light," being presented by D. McFarlan Moore, the inventor of the system, in the meeting room on the sixth floor, and the paper by Sergius P. Grace, entitled "The Telephone Wire Plant," being presented in the auditorium.

Both meetings were called to order at 8.15 P. M. The secretary announced that at the meeting of the board of directors held during the afternoon, 154 associates had been elected. The following associate members were transferred to the grade of member: Cyrus Wellington Koiner, St. Louis, Mo.; C. E. Magnusson, Seattle, Wash.; L. H. Thullen, Pittsburg, Pa.; R. F. Hayward, Mexico City, Mexico; P. Junkersfeld, Chicago, Ill., and A. B. Herrick, New York city.

Mr. Moore preceded the reading of his paper with a few remarks concerning the efficiency of his system of illumination. The room was illuminated by a rectangle of Moore tubing, by the regular system of incandescent lamps behind the cove, and by a string of suspended naked incandescent lamps. Notwithstanding the fact that both systems of incandescent lamp lighting were consuming a considerably greater wattage, the illuminometer measurements showed, he said, that the Moore tube was working at a higher efficiency.

The light in the Moore tube emanates with uniformity from the entire area of a single, continuous glass tube one and three-quarters inches in diameter, and in the form of a rectangle sixty-two feet by twenty-five feet. The glass tube was thirteen inches from the ceiling, and sixteen feet from the floor. The two ends of this continuous tube at the centre of the rear side of the rectangle approached within a short distance of each other, and extended horizontally through the wall into a rigid steel terminal box located on the wall of a closet at the rear of the hall. This terminal box contained the necessary electrical apparatus, and was fed by sixty-cycle alternating current at 220 volts, supplied from the street mains of the United Electric Light and Power Company. Besides the two carbon electrodes of the tube, the terminal box contained a step-up transformer and a small specially designed valve with the solenoid. This valve, designated as the feeder valve, represents an entirely new departure in vacuum tube lighting, and one that is vital to its success.

The high-potential terminals of the transformer within the terminal box are only two inches in length, and are attached directly to the electrodes within the box. All the high-potential wires, therefore, remain within the box, which has a wire seal placed upon it.

Changes in the degree of vacuum in the tube alter the resistance to the flow of current. The problem of devising a thoroughly practical means for replenishing the gaseous conductor was solved by the construction of the feeder valve, which permits air or any other gas to enter the tube only when it is needed, and in such a manner that it is entirely automatic.

The feeder valve is constructed of a piece of seven-eighths-inch glass tubing supported vertically and contracted at its bottom end into a three-eighths-inch glass tube which extends into the main lighting tube. At the point of contraction at the bottom of the seven-eighths-inch tube there is sealed, by means of cement, a one-quarter-inch carbon plug, the porosity of which is not great enough to allow mercury to percolate through it, but which will permit gases easily to pass, due to the high vacuum of the lighting tube connected to the lower end of the plug and approximately atmospheric pressure above it. The carbon plug is normally completely covered with what would correspond to a thimbleful of mercury. This seals the pores of the carbon plug and has nothing to do with the conducting properties of the gas in the main tube which produces the light. A soft-iron core, actuated by a small solenoid connected in series with the transformer, lifts the concentric glass tube partly out of the mercury, the surface of which falls, causing the minute tip of the carbon plug to be slightly exposed for a second or two, and an extremely small quantity of air or other gas filters through, finding its way into the vacuum tube proper. In normal operation the tubes expose this carbon tip for about one second in every minute.

Several comparative illumination tests were outlined, one test showing the tube system to have 5.1 times the illuminating efficiency of an incandescent lamp system which it displaced, and another showing the tube system to have an efficiency of 2.9 times as great as an enclosed arc lamp system which it displaced. Mr. Moore uses the hefner foot in calculating his illuminating efficiencies.

The color of the light, which can be varied according to the gaseous constituent which is used in the tube, is important. The yellow light, which is due to the use of nitrogen, is more efficient than the white light, which closely approximates artificial daylight, and which is due to the use of carbon dioxide.

The Moore tubes are now used in lengths varying from forty to 220 feet. On the basis of the yellow light, when the tubes are operating at twelve hefners per foot, which is the average intensity now used, tubes from forty to seventy feet use a two-kilowatt transformer; from eighty to 125 feet, a 2.75-kilowatt transformer; from 130 to 180 feet, a 3.5-kilowatt transformer, and from 190 to 220 feet, a 4.5-kilowatt transformer. In order to ensure a steady light, the power-factor of the circuits supplying these transformers averages at present sixty-five per cent. This is obtained either by using a shell type of transformer of special design, with a leakage reactance of about sixty-five per cent, depending on the size of the transformer required; or a standard type of core transformer operating in series with a special type of adjustable inductance consisting of two opposing coils on the centre leg of an iron core of the shell-type formation.

The degree of vacuum required in these tubes is about 0.1 millimetre. This vacuum is maintained within 0.01 millimetre, or 0.00001 per cent of an atmosphere either above or below the normal degree of vacuum.

These long tubes are built in place by hermetically sealing together eight-foot, six-inch lengths of glass tubing by means of a new blast illuminating gas-fire or double-flamed torch. The work can be done rapidly and cheaply. The two ends of the tube within the terminal box each contain a graphite electrode eight inches long. Immediately in front of one of these electrodes a branched small-bore tube extends to the bottom of the feed valve, and the other branch is available to be connected temporarily by a rubber hose to a new, small, portable oil vacuum pump. The electricity is turned into the tube shortly after the pump is started, and the amount of light resulting indicates, in a measure, the degree of vacuum in the tube. However, an accurate vacuum gauge calibrated to measure to one-ten-millionth of an atmosphere has been developed for this work. As soon as the vacuum of the tube is sufficiently high, the feed coil is adjusted to feed at proper intervals the right quantity of air or other gas. When the light automatically

and continuously feeds itself from the atmosphere, the supply of which is, of course, inexhaustible, its life can be said to be indefinitely long. To feed the tube on nitrogen, the air is simply made first to pass through a small iron cylinder containing enough phosphorus to last several years. To feed the tube carbon dioxide, a bottle containing a piece of marble and a little hydrochloric acid automatically generates the gas only when the tube requires feeding.

Portable or unit forms of this light have been developed. These operate on 220 volts, and require twenty-five per cent less watts, and give twenty-five per cent more illumination, than an enclosed arc.

The paper states that after becoming accustomed to the tube light, workmen, whether machinists or employés in packing or shipping departments, very much appreciate its shadowless characteristics. The Moore tube, the author considers, is a logical development of lighting practice, and is the system which solves the problem of approximating artificial daylight. Stroboscopic tests of the light tube reveal an image better than that obtained from enclosed arc lamps, notwithstanding the fact that the heat constant of the tube as the current wave passes through zero is less than that of any other form of light. Tubes of this nature will operate successfully on all frequencies, but at frequencies as low as twenty-five cycles the images will probably become too pronounced, unless two or three-phase currents are available, in which case, by the use of multiple tubes, the images of moving objects are entirely removed. The highest frequency in use at present for operating these tubes is 480 cycles, and is furnished by a motor-generator on 220 volts direct current. Careful tests on varying frequencies up to 10,000 cycles have shown that the number of alternations of the current used to excite these long tubes has nothing to do with their efficiency.

Mr. Moore suggested a way to compare all forms of illuminants, which he thought would establish a fair basis for specifications. The area to be lighted should be about forty by eighty feet. The illuminant must not extend below a horizontal plane ten feet above the floor, the award to be made entirely upon the results of illuminometer tests in a plane thirty inches above the floor, the stations of which are to be located as follows: ten equal spaces on the centre line of the longer dimension; ten equal spaces on the centre line of the shorter dimension, and ten equal spaces on the diagonals. The average of these thirty readings is to be divided by the total number of kilowatts used from the street mains by each form of illuminant, and the highest quotient, light units per energy unit, will determine the placing of the award.

Gano S. Dunn, the chairman of the evening, in opening the discussion, said that he felt that the members had been listening to an exposition of a new art. He paid a high tribute to the perseverance and the courage with which Mr. Moore had attacked this problem, and congratulated him upon the step which had been made in developing this system to its present condition of commercial application. He then called upon Dr. C. P. Steinmetz to continue the discussion.

Dr. Steinmetz took exception to the results announced in the paper concerning the comparative illumination tests, and suggested that the poor showing made by the incandescent lamps and the arc lamps was due to their being placed in such positions that the best illuminating values were not possible. He did not believe that the Moore tube system would show to any better advantage than the other systems of lighting, when proper consideration was given to the characteristics of each. After all, to his mind, it was the matter of the illuminating flux which counted. It was not alone a matter of getting a certain illuminating efficiency, but the question arose, what possibilities of distribution were at the command of the illuminating engineer after he had produced his light. He regretted the use of the hefner by Mr. Moore, and strongly endorsed the use of the British candlepower. The efficiency of the Moore tube was not as good as that of the tungsten lamp. The tungsten lamp, while being a source of high initial efficiency, could be so enclosed by proper reflectors and diffusers that, while there was a considerable loss in efficiency, a better illumination was secured. Mr. Moore, in his paper, made the statement that the blinding glare of the mercury vapor lamp was disadvantageous. Dr. Steinmetz had not found it so. He was using the mercury vapor lamp for artificial lighting, and had found it so satisfactory that he would continue to do so. While criticizing these points, however, Dr. Steinmetz emphasized the fact that Mr. Moore was to be congratulated upon the work he had done with this system of lighting. The matter of automatically feeding the gas into the tube and maintaining the vacuum within such close limits was a remarkable achievement, and Mr. Moore deserved the highest praise for the ingenuity he had shown in bringing this tube system of lighting into such a practical commercial form.

Percy H. Thomas said he thought it was a fine thing to have the engineering data concerning the Moore tube system placed before the Institute. He thought Mr. Moore was entitled to a vote of thanks for giving such a frank exposition of his system. One of the strong points in favor of the Moore tube system of lighting was the doing away with outlets and extra wiring, the elimination of the fire risk, and the reduction of danger from the distributing system. He challenged the statement that the Moore tube approximated artificial daylight. He thought that the Moore light, like other lights of the same character, would show a banded spectrum, and daylight showed a continuous spectrum. He considered that the system had an advantage in making measurements of illuminating intensity over other systems, in that the measurements could be made in the plane most favorable to the system. The shadowless feature of the system was not an advantage. It had advantages in its very fair efficiency, its diffusibility, but in its indivisibility it suffered a considerable disadvantage. He thought it possible that the mercury seal would not be of such a permanent character that it would seal the tube indefinitely from the encroachment of air. With regard to the life of the Moore tube, he said that he knew of mercury vapor lamps burning regularly for 10,000 hours, and had heard of cases where mercury vapor lamps had burned for 16,000 hours.

Dr. Clayton H. Sharp said that every engineer regretted the low efficiency, from a thermodynamic point of view, of our present illuminants. It was also an occasion for regret that Mr. Moore's endeavors to secure a tube light of extremely high efficiency had so far resulted in failure. The gain in efficiency with the Moore lamp was not revolutionary; it was less than that shown by the tungsten lamp. Any new system of lighting, to be distinctly advantageous, must show advantages which the other systems do not possess. Dr. Sharp emphasized the disadvantage of the Moore system because of its indivisibility. He thought this would make it necessary to supplement the Moore system by some other system of lighting. It would not be wise to place too much reliance upon this single system of lighting. He took exception to the specification which Mr. Moore had elucidated for comparing various types of illuminants. The problem which the illuminating en-

gineer had to solve was one which was not in any way general. Certain conditions had to be met, and the illuminating engineer had to do the best he could under the circumstances. There could not be any specified system of studying illumination; the engineer must generalize. Dr. Sharp also criticized the use of the hefner unit.

John W. Howell warmly congratulated Mr. Moore upon the development he had made in his system. He had added a commercial illuminant to those which the electrical engineer had at his disposal. He thought that this system of lighting would be particularly adaptable to art galleries. He quoted the experience had in Germany and elsewhere on the Continent, where it was not possible to view paintings at night, because of the danger from fire through artificial illuminants. The system would appear to be ideal for this service.

Leon Gaster, representing the British Institution of Electrical Engineers and the Faraday Society, said that he was very much interested in the subject of illuminating engineering, and had been delighted to meet with so many men in New York who were doing such remarkable work in this field. Mr. Gaster raised the question as to the ultimate influence the Moore tube system of lighting would have upon the human eye. He said that while we disregarded these things a good deal in America, it was a very vital point that he would have to be prepared to have full information upon when he returned to England.

In closing the discussion, Mr. Dunn said that aside from the results which might appear from photometric measurements, the engineer should take into consideration the practical demonstration which was being afforded. Notwithstanding the fact that the cove system of lighting was using something like ten kilowatts, the naked incandescent lamps five kilowatts and the Moore tube four kilowatts, the illumination seemed to be very much better with the Moore system. He then invited Mr. Moore to reply to those questions which he thought required further consideration.

Mr. Moore thanked the members who had discussed his paper, both for their criticisms and for their encouragement. Contrary to Mr. Thomas's idea, he said the Moore tube showed a continuous spectrum, and not a banded spectrum. When he said that the tube had a longer life than any other system of illumination, he meant that at the end of 4,000 or 5,000 hours the tube would be in the same condition as when it had been put up. The system as it has been developed up to the present time did not blacken the tube. Regarding any statement concerning the power-factor, he said that this was very well answered by the cold fact that the system which was lighting the hall was operating at a power-factor of seventy-five. Concerning the use of the hefner unit, he said that he had found this to be distinctly advantageous. It was the unit which had been strongly endorsed by the standards committee of the American Institute of Electrical Engineers, and that, finding it so practical, he would continue to use it.

Concerning the matter of images which the alternating current used with the system made possible, he said that at higher frequencies these images disappeared, but that he had been agreeably surprised to find that even in machine shops, where it might be expected that the use of an alternating current of comparatively low frequency would bring down condemnation upon the system, it had met with absolutely no objection.

The meeting in the auditorium was presided over by J. J. Carty, chief engineer of the New York Telephone Company. Mr. Carty called for the paper of the evening.

The paper entitled "The Telephone Wire Plant" was presented by Mr. Grace. A full report of this meeting will appear next week.

Westinghouse Electric and Manufacturing Company.

In a statement to the stockholders of the Westinghouse Electric and Manufacturing Company, President George Westinghouse says, in part:

"The business of the company during the past year largely exceeded that of any preceding twelve-month period, and continues to increase. The orders entered during March, 1907, by the East Pittsburg works were $4,006,348, and by the subsidiary manufacturing companies, $379,229.

"The following is a statement of orders received during the past five years by the East Pittsburg works and the subsidiary companies:

Year ended March 31, 1903	$21,916,178
Year ended March 31, 1904	20,822,010
Year ended March 31, 1905	18,811,790
Year ended March 31, 1906	28,154,663
Year ended March 31, 1907	38,317,918
Value of unfilled orders March 31, 1907	14,616,441

"This great increase in your company's business, coupled with higher costs of labor and material, has necessitated a large increase in working capital, to insure the successful carrying on of enlarged manufacturing operations, as will more fully appear from the statement below. At the same time the amount invested in current accounts with customers for apparatus delivered or in process of erection has been correspondingly increased.

"The value of working assets on February 28, 1907, and the increases compared with November 30, 1905, this being the date of the balance sheet contained in the circular letter to the stockholders dated January 23, 1906, are as follows:

"Westinghouse Electric and Manufacturing Company and subsidiary manufacturing companies:

		Increases.
Raw materials and supplies	$4,916,150	$2,162,132
Work in progress	7,355,533	4,053,258
Finished parts and completed apparatus	4,378,038	387,273
Goods on consignment for resale, etc.	1,398,529	368,851
Totals	$18,048,251	$6,971,515
Accounts and bills receivable	$11,431,075	3,776,500
Total increase		$10,748,016

"The following is a consolidated statement of income and profit and loss for eleven months ended February 28, 1907:

Gross earnings:		
Shipments billed		$30,659,579
Cost of shipments, including factory costs, selling, administration and general expenses		26,206,445
Net earnings		$4,453,134
Other income:		
Interest and discount	$371,084	
Dividends and interest on sundry stocks and bonds owned	445,145	
Miscellaneous royalties, etc.	484,224	
Total other income		1,300,454
Total income		$5,753,588
Deductions from income:		
Interest on bonds and debentures	$776,242	
Interest and discount	728,487	
Tax on capital stock, premiums on debentures retired, commissions, etc.	57,730	
Depreciation of property and plant equipment, accounts and bills receivable, sundry stocks and bonds, etc.	607,351	
Total deductions		$2,169,811
Gross surplus for period		$3,583,776
Dividends for the period		2,291,272
Net addition to surplus for the eleven months		$1,292,504

"The results shown by the consolidated statement of income and profit and loss of your company and its subsidiary companies, for the eleven months ended February 28, 1907, excellent as they are, have, however, been adversely affected by the extra cost of development of manufacturing facilities incident to a rapidly increasing production. With the increased facilities already provided and those nearing completion, the production for the fiscal year beginning April 1, 1907, should greatly exceed that for the past year.

"The income to your company during the past year from interest, dividends and earnings on its investments, including those received from affiliated companies, foreign and domestic, was above five per cent on the aggregate book value of all such securities. The managements of these several companies have been brought to a high efficiency, with the result that the business of each has shown a large growth."

The Home Telephone Company, Ironton, Ohio.

A New Automatic Central Energy System.

THE American Automatic Telephone Company, of Rochester, N. Y., was incorporated in January, 1906, under the laws of the state of New York, to manufacture and sell automatic telephone switchboards, with the right to engage in the general manufacture of telephone apparatus, if desired. Suitable preliminary factory quarters were at once selected, and the necessary machinery and dies acquired. The company preferred to begin operations with an entirely new automatic system, based upon new principles in the automatic art. The system has been developed and perfected by careful and severe tests of parts, painstaking experiments and practical applications. The first application was in the Ellis Hospital, Schenectady, N. Y., which was soon followed by a system in the Eastman Kodak Works, Rochester, N. Y. The latest application is the subject of this article, namely, the exchange of the Home Telephone Company, Ironton, Ohio. This exchange is equipped for four hundred direct lines and one hundred four-party lines, making in all eight hundred telephones.

The arrangement of the switches and the switchboard frame, of which there are two sections, are shown in Fig. 1 and Fig. 2. Fig. 2 shows the switchboard frame with its encasing cabinet. The latter is made of highly polished golden oak, with glass panels. As may be seen from the illustrations, the switches in this installation are arranged in tiers, there be-

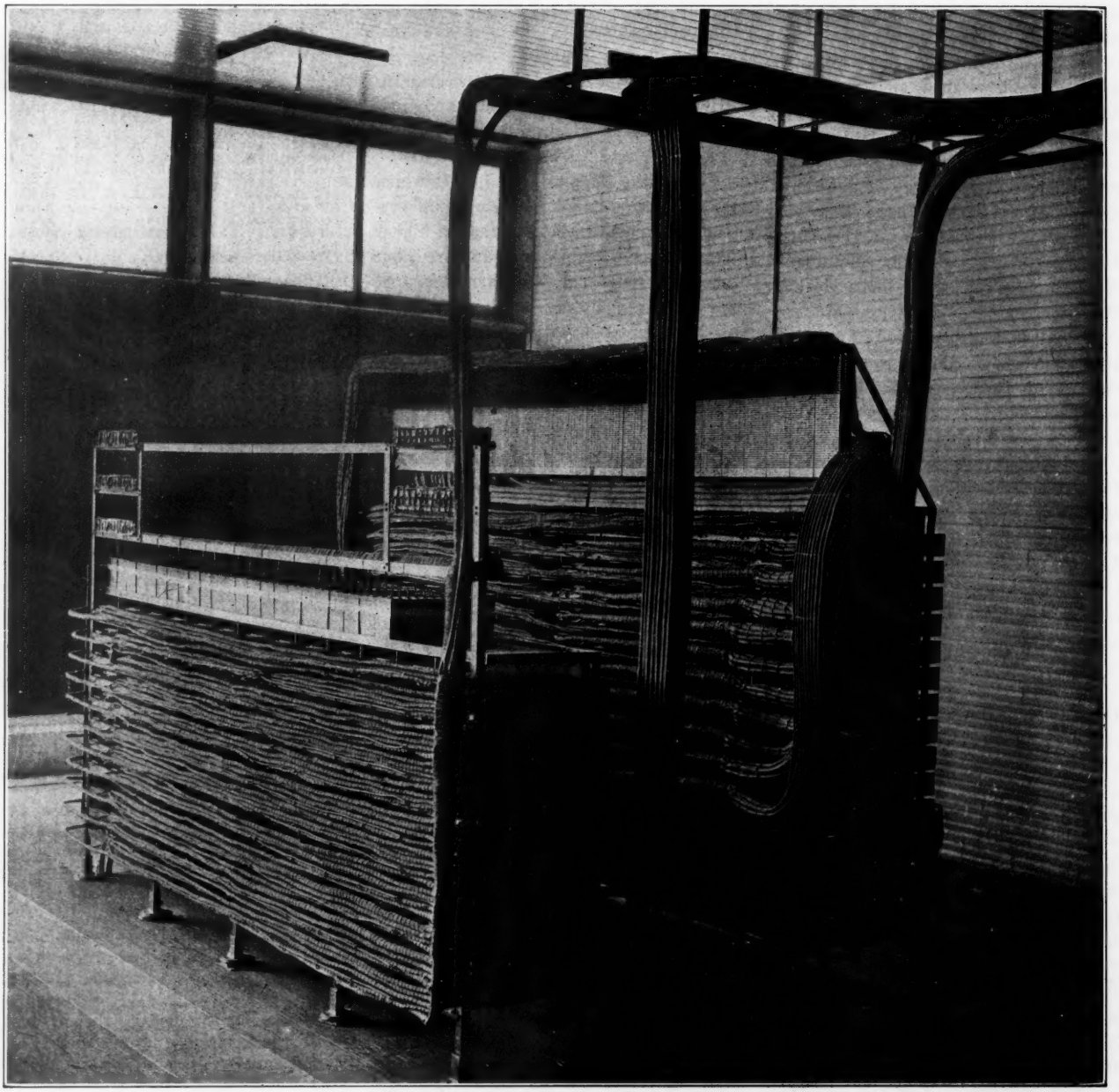


FIG. 1.—ARRANGEMENT OF SWITCHES IN SWITCHBOARD FRAME, AUTOMATIC TELEPHONE EXCHANGE OF THE HOME TELEPHONE COMPANY, IRONTON, OHIO.

ing eleven rows of thirteen switches in division 1 and sixteen rows of thirteen switches in division 2.

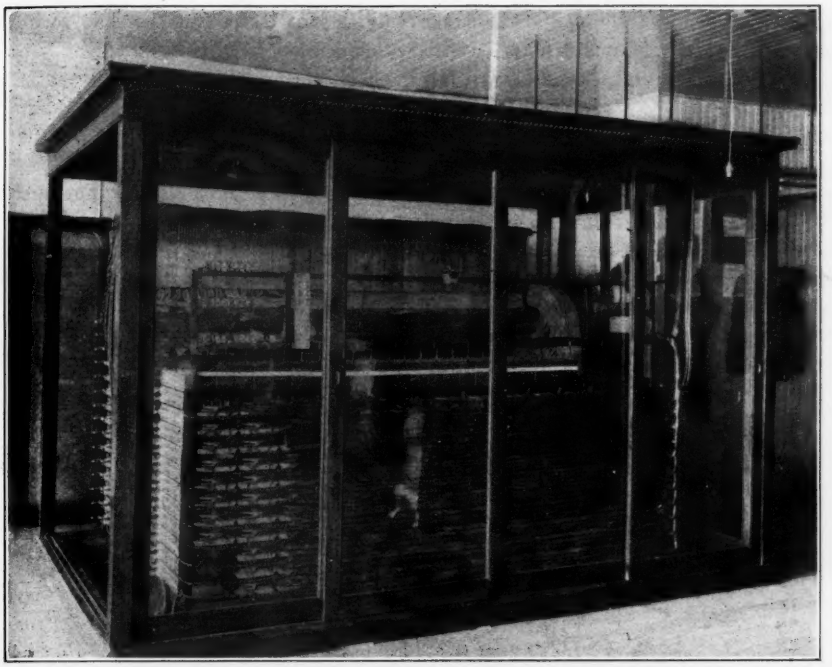


FIG. 2.—SWITCHBOARD FRAME IN ENCLOSING CABINET, AUTOMATIC TELEPHONE EXCHANGE OF THE HOME TELEPHONE COMPANY, IRONTON, OHIO.

There is an entrance door at one end of the enclosing cabinet, and the sides are provided with sliding doors, so that the switches and wiring are readily accessible, and are at the same time thoroughly protected against dust. In addition to the dust protection afforded by the cabinet, the construction of the switches and their arrangement in the frame is such that they are self-protected from dust. All contact springs are horizontal, and no contact is exposed to dust settling by gravity.

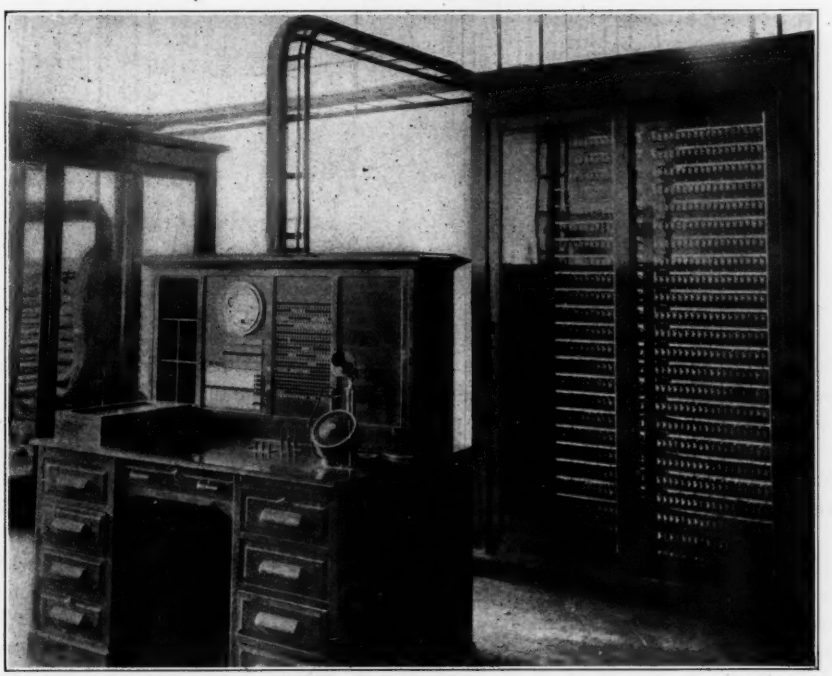


FIG. 3.—RELAY RACK AND WIRE-CHIEF'S DESK, AUTOMATIC TELEPHONE EXCHANGE OF THE HOME TELEPHONE COMPANY, IRONTON, OHIO.

Fig. 3 shows the relay rack, with its polished golden oak and glass encasing frame, and also the wire chief's desk. Fig. 4 shows power equipment.

The company claims that it is the first to have adopted a central energy system of automatic exchanges. In doing so it has developed it along manual lines in methods of operation as closely as possible, wherever it was desirable, thus making the scheme more readily understandable by manual men, and less difficult to educate attendants. The system uses two wires, making no use of the ground for selective purposes. The two-wire system has also made it possible to develop an exceedingly simple substation selector, there being only one electrical contact, and that with a commutator arrangement similar to a dynamo, except, of course, that there is but one segment on the commutator. It has thus been possible to eliminate fine adjustments, reducing the cost of substation maintenance and increasing reliability.

At Ironton the system is provided with Dean harmonic party lines, but any system of selective ringing can be used, and party lines may be equipped with lock-out attachments of simple design, if desired, making secret service possible on party lines as well as on direct lines.

Automatic pay stations may be provided, if desired, in which coins are automatically taken, or returned, depending only on whether the called party has, or has not answered. If the called party does not answer, the coin is returned to the calling party. The instrument will also discriminate between rates automatically, and will measure the time for both original and fractional periods, compelling the payment of proper amounts, if conversation exceeds a predetermined period. Under certain circumstances coins will be returned after service has been rendered; for example, where a party is called who has advertised to pay for all incoming calls, or where a subscriber desires to use a pay station to report trouble to the management, in which case the coin is always returned. If more coins are deposited than are required by time of conversation, the balance of such coins is returned to the calling party when the receiver is hung up. All coins collected at pay stations are automatically recorded on a meter in the central office, affording a check on collections.

Metered service may be provided, where it is desired to operate a service on a metered basis, arranged to register in the central office every call that has been answered. This is done mechanically and electrically, and is not dependent upon an

attendant. Meters can be arranged to register all calls, either outgoing, incoming, or both. Furthermore, the registers may be arranged so that they will not record calls which should not be recorded, such as, for example, a call to the company's management to report a defect in service. They can also be arranged to record at different rates, depending upon the rate determined for the place in which the called party is located; or they may be arranged to record on the basis of elapsed time in the use of telephones.

Figs. 5 and 6 represent, respectively, the switch base and bank base, with operating mechanism, consisting of the motor magnet shown at the right of switch base; release magnet shown at left, and a ratchet wheel carrying brushes for making connection with the bank contacts.

The motor magnet has a spring steel driving pawl attached to the upper extremity of its armature, which engages with the teeth of the ratchet wheel, and serves as the means of moving the wheel forward one step each time the motor magnet is energized. It is possible to drive this wheel forward over its entire course in one-half second, and to stop it with precision while moving at that rate with its brushes resting upon any one of the bank contacts desired.

Just back of the driving pawl there is another spring steel pawl, which also engages with the teeth of the ratchet wheel. This pawl serves, when the switch is in operation, to retain the ratchet wheel in any position to which it may have been advanced by the driving pawl.

To the armature of the release magnet there is attached a steel release spring, the upper end of which normally rests against the left-hand end of the driving pawl. This spring is provided with a notch just below the point at which it rests against the driving pawl, the arrangement being such that when the release magnet is energized the release spring is moved forward until the notch passes over the end of the driving pawl, thus when the release magnet is de-energized, the release spring draws both the driving pawl and the retaining pawl from engagement with the teeth of the ratchet wheel, allowing the latter to return by its spring tension to its zero position. The first following movement of the motor magnet displaces the release spring and permits the driving and retaining pawls to again engage the teeth of the driving wheel.

Current is fed to the brushes by the feeder springs attached to the right-hand end of the bridge which supports the shaft of the ratchet wheel. The ends of these feeder springs press upon segments at the lower end of the brushes.

The switches are equipped with male jacks, as shown at the top, and the banks with female jacks, located to coincide with each other. All switches of a certain class are interchangeable. It is therefore possible to remove and replace one by another in a second or two. The service is in no way disturbed while the change is being made. This feature is important because it admits of the adjustment of switches at a convenient testing table, after which they can be placed in the frame with assurance that they are in proper working order. Another feature of the arrangement of the bank and switch bases is the positive alignment when the switch is inserted in the bank base. The male portion of the switch is provided with a tongue which is A-shaped at its edges, and the female portion of the bank base is provided with V-shaped grooves into which the A-shaped tongue is inserted, making absolute alignment between the switch and the bank, both horizontally and vertically.

The bank base is of the four-point type, two rows of contacts being for line connections and two rows for exchange control purposes. This is the largest bank in use in any exchange. A large per cent of the banks have only three rows and some only one row of contacts.

In practice the brushes of the switch never pass off of the bank contacts. The normal position of these brushes when the switch is at rest is on the first contact of the bank. It is thus possible to adjust the brushes with a firm spring tension against the bank contacts, thereby assuring a more perfect contact than would be possible were the brushes normally out of engagement with the bank contacts, as has heretofore been the practice. For this reason no calls can be missed by a failure of the brushes to properly enter upon the contacts. The switch has but one movement, namely, horizontal.

Tests have been made in which switches have operated over the entire bank of contacts 500,000 times without intermission or failure, and running day and night for that purpose. As fifty steps are necessary to pass the brushes over the entire bank of contacts, it follows that the pawls engaged the teeth of the ratchet wheel 25,000,000 times in this test. At the end of the test the pawls and the ratchet wheel were found to be in good working condition, showing scarcely any wear, in fact, the teeth and the pawls were not much more than polished. As these are the only wearing parts in the switches, and as the test greatly exceeded the possible requirements of many years of actual service, a further test was considered needless, and it was therefore discontinued.

Fig. 7 is a standard central energy wall

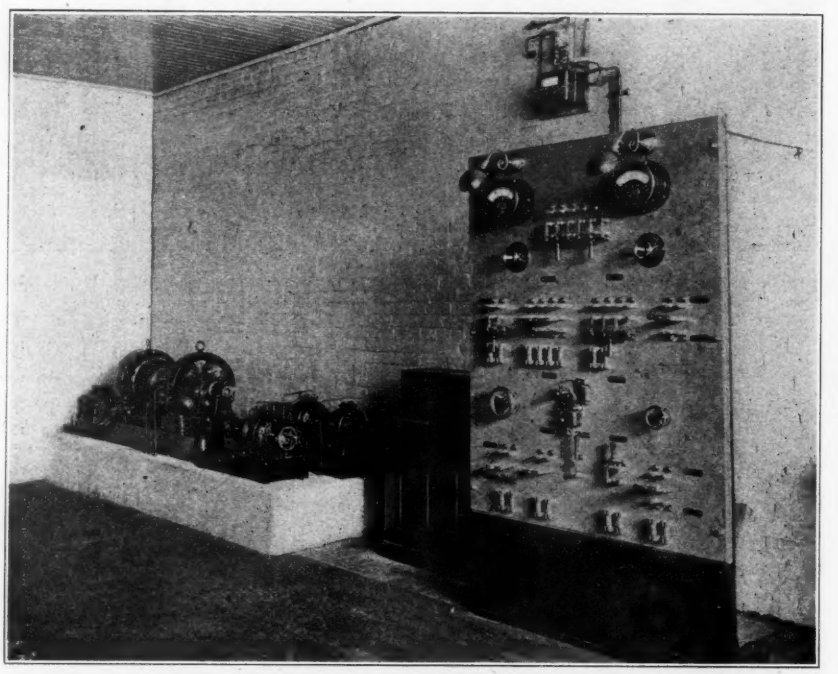


FIG. 4.—POWER EQUIPMENT, AUTOMATIC TELEPHONE EXCHANGE, HOME TELEPHONE COMPANY, IRONTON, OHIO.

telephone equipped with a substation selector. The change necessary to convert it into an automatic was to open the line circuit on the rear of the backboard, extend the two ends through the backboard, and connect them to the commutator contact of the substation selector. This can be done with any style of central energy wall telephone; moreover, if it is desired to change an existing manual plant to automatic, it can be done without removing the telephone from the premises, and without interruption to the service, except for the brief interval occupied in attaching the substation selector, and after the substation selector has been attached, the telephone may continue to be used manually

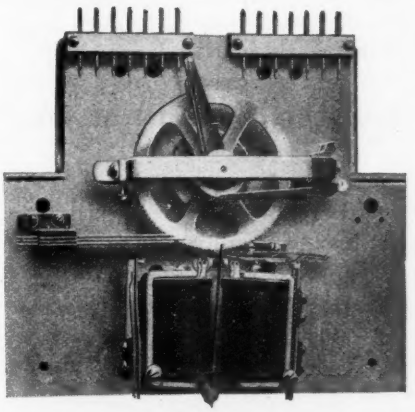


FIG. 5.—SWITCH BASE.

until the automatic central office equipment is installed, at which time it will only be necessary to transfer the lines in the central office from the manual board to the automatic board to complete the automatic service.

As the substation selector is the only piece of equipment located outside of the central office, it has been made exceedingly simple, durable and reliable, to avoid frequent inspection, adjustment and repairs. The additional maintenance on substation apparatus is thereby reduced to a minimum. It will be, it is said, a trifle over that of a manual telephone, and this will be more than counterbalanced by the reduced cost of maintenance upon the central office equipment.

Each substation set may be supplied with a lamp, if desired, receiving its current from the central office over the telephone wires, lighting the dial as soon as the subscriber removes the receiver from the hook. The light will be sufficient to find the number for making calls, or the numbers in the directory, without first illuminating the room.

To call with this substation selector the receiver of the calling party is first removed from the hook. The pin is then inserted in the hole on the dial of the substation selector corresponding to the first number of the combination desired, and by means thereof the dial is revolved to the right as far as it will go, after which

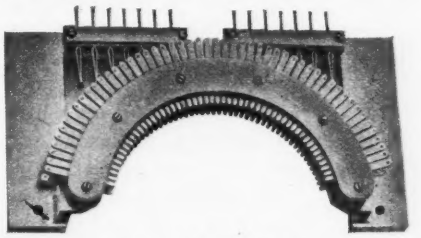


FIG. 6.—SWITCH BANK.

it is allowed to rotate back by its own spring tension to its normal position. The operation is repeated for the second, and all following combinations desired. In rotating backward the mechanism of the substation selector opens and closes a single commutator contact a number of times corresponding to the number of the hole in which the pin has

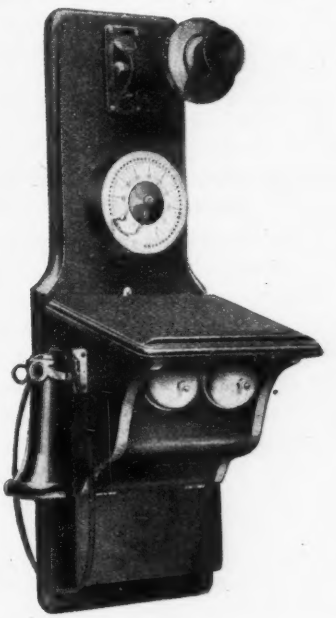


FIG. 7.—WALL SET WITH SUBSTATION SELECTOR.

been inserted, thus transmitting its impulses to the switches. With two movements of the dial it is possible to select any of 2,500 subscribers, and with three movements this number may be increased to 125,000 selections. Hanging the receiver on its hook opens the circuit, releases the switches and restores them instantly to normal. The release being instantaneous, it follows that the calling subscriber is immediately able to make another call.

The system of numbering is different from any other system, either the present manual or automatic, and is known as the hyphenated number system, either single or double numbers being transmitted at one time as desired, and as hereafter described.

When a busy telephone is called, an audible busy test is transmitted to the subscriber. In large exchanges it is practical to use a phonograph, or telegraphone, to announce the fact when a busy line is called.

As there are less switches than there are telephones, the lines being represented by a line and cut-off relay, as in manual practice, instead of a switch, successive calls rarely pass through the same set of switches, hence should a subscriber in

FIG. 8.—DESK SET WITH SUBSTATION SELECTOR.

making a call happen to select a switch which has for some reason failed, it is only necessary for such subscriber to restore his receiver to its hook, remove it again, and repeat the call. In the latter case an entirely new set of switches and circuits will be assigned. The wire chief, however, will have received notice through lamp supervision located on his desk of the defective switch, which can be replaced with a perfect switch in a second or two.

The system herein described is one in which two motions of the dial are used to complete a call. The switches necessary to an exchange based on two motions of the dial are Distributor, B, C, D, X, and G switches. When a subscriber removes the receiver from the hook, the talking circuit is closed through the springs of the substation selector, or calling device. This operation energizes the line relay, which removes the ground battery from the contact representing the calling subscriber on a row of semicircular bank contacts. Above this "busy" row of contacts and swept by wipers mounted on the same shaft are the corresponding rows of "line" and "mate" contacts. Thus on the banks

of a "B" switch there are three rows of fifty contacts representing the "line," "mate" and "busy" of fifty subscribers' lines. On the instant that the line relay acts, a distributor switch is started by the forward contact on the line relay springs. This distributor switch in its rotation throws ground on a bank point representing the starter wire of a "B" switch in the group from which the call is to be made, starting it to sweep its arc of bank contacts. As soon as the wipers have traveled to the point from which the ground has been removed on the "busy" row of contacts, the calling subscriber's line has been found and, having found the caller, it stops, returning ground battery to the point from which the line relay had removed it. In stopping the "B" switch also throws ground on a corresponding point in a fourth row of contacts on the banks of the "B" switch. This last-mentioned ground contact operates the cut-off relay.

On the same instant that the "B" switch leaves its normal position in its search for the calling line, the "X" switch starts to rotate in search of an idle "C" switch. The "B" and "X" switches being in series, then, the subscriber is now connected direct to the line jacks on the "C" switch, which may call into any one of fifty groups, each group representing fifty subscribers. The above operations are accomplished in from one to one and one-half seconds.

The group to be reached is designated by the first number called on the dial at the calling subscriber's station. The calling device, or substation selector, has only two springs. These, with the receiver hook springs of the common battery variety, are the only springs in the subscriber's station. The springs in the substation selector are normally closed, and are so arranged that the contact is opened and the circuit interrupted when the dial is operated. These interruptions always correspond to the number pulled on the dial, which may be from 1 to 50. Thus, if 35 be pulled on the dial, the impulses occasioned by opening the circuit thirty-five times would be taken up by the mechanism and magnets of the "C" switch, causing it to rotate to the thirty-fifth point on the bank contact arc. This thirty-fifth point, then, represents a trunk to the thirty-fifth group of fifty subscribers. All the trunks to this group are terminated on the banks of the "D" switches for this group, and these "D" switches find the calling trunk in practically the same manner as the "B" switch found the subscriber's line. Then comes the operation of calling 21 on the dial and the connection with the substation 35-21 through the "G" switch, which is the last to rotate, is completed. This "G" switch is equipped with a greater number of relays, and has a more complex circuit for purposes of ringing the called subscribers' bells, detecting busy lines, etc. When a subscriber is done talking he hangs up his receiver, which makes his line test open. This permits certain relays on the switches to make back contacts, which operate to release the call, and restore the switches to normal.

On party lines in this system the group of fifty subscribers is in reality four groups, on the banks of which are represented fifty line circuits. A certain number (any that is desired) of "G" switches is supplied with sixteen-cycle harmonic ringing current, then for each of thirty-three, fifty and sixty-six-cycle ringing current the same number of "G" switches are installed. To the banks of all these "G" switches all the fifty line circuits are multiplied straight through, so that the initial number of the call to any one of these party line subscribers merely indicates which ringing current is desired on any one of these fifty lines.

Fig. 8 shows a standard desk stand with substation selector attached.

Chicago Jovian Club to Give an Operetta.

The Chicago Jovian Club purposes giving an operetta or musical comedy on Thursday evening, May 16, at the Association Auditorium, 153 La Salle street, Chicago, Ill. It is expected that a number of the Sons of Jove, their wives and relatives, and several professionals, will be featured. An orchestra of twelve pieces will render the musical selections, and it is planned to have fifty people upon the stage. Both from a financial and social standpoint, this entertainment is expected to be a great success. The tickets are $1 each, all seats reserved. The seating capacity of the house is 965. Tickets may be secured from A. D. Blocker, secretary and manager, 139 Adams street, Chicago.

Cotton Manufacturers' Medal Presented to C. B. Burleigh.

At the annual meeting of the National Association of Cotton Manufacturers, held on April 24 at the Massachusetts Institute of Technology, Boston, Mass., the association medal was presented to Charles B. Burleigh, in acknowledgment of the merits of a paper read before the association at its fall meeting, September 13, 1906, entitled "The Curtis Vertical Steam Turbine."

Electric Service in the New York Central Tunnel.

Electric service between the Grand Central Station and High Bridge, N. Y., on all trains of the New York Central & Hudson River Railroad was instituted on April 23. For several months past most of the local and suburban trains have been drawn out of the Grand Central terminal by the new electric locomotives. On April 23, however, for the first time, the Twentieth Century Limited, the Empire State Express and the other luxurious through trains for the west were hauled through the tunnel by electric locomotives. It is stated that from now on all trains entering or leaving the Grand Central will be hauled from or to High Bridge by electric locomotives.

Iowa State Electrical Association.

The annual meeting of the Iowa State Electrical Association was held at Clinton, Iowa, on April 20 and 21. The following officers were elected: president, G. S. Carson, Sioux City; vice-president, L. D. Mathes, Dubuque; secretary, W. N. Keiser, Dubuque; treasurer, W. A. Mall, Belle Plaine. Executive committee: A. L. Todd, Charles City; P. B. Sawyer, Des Moines, and Gus Lundgren, Cherokee. The officers are also members of the executive committee.

The next annual meeting will be held in Des Moines.

The Iowa Street and Interurban Railway Association.

The annual meeting of the Iowa Street and Interurban Railway Association was held at Clinton, Iowa, on April 20. President F. J. Hanlon, of Mason City, and the other old officers, were re-elected. The vice-president is P. P. Craft, Clinton; secretary-treasurer, L. D. Mathes, Dubuque.

The next annual meeting will be held at Des Moines.

Navy Department Purchases.

The Bureau of Supplies and Accounts, United States Navy Department, will open bids in Washington, D. C., on May 14 for the following electrical material: Single-pair cable, 800 yards, for delivery at New York; fifteen circuit-breakers, for delivery at Washington, D. C.; 2,150 feet of ebonite, for delivery at Newport, R. I.; 2,450 yards of magnet wire, for delivery at New York.

Theodore N. Vail Elected President of the American Telephone and Telegraph Company.

Frederick P. Fish has resigned as president of the American Telephone and Telegraph Company, and Theodore N. Vail has been elected in his place. In connection with his resignation, Mr. Fish states that for over two years he has been waiting for a favorable opportunity of retiring and resuming the practice of law. It is stated that he will continue to serve the company as one of its legal advisers.

Theodore N. Vail has had many years' experience in telephone affairs. He is one of the four original telephone men in the United States, and as a resident of Washington, D. C., where he was superintendent of mails for the United States Government, was associated with Alexander Graham Bell, Gardiner G. Hubbard and Thomas A. Watson, not only before there was any telephone company organized, but before a commercial telephone had been

MR. THEODORE N. VAIL.

invented. With Mr. Hubbard, Mr. Vail organized the first Bell company for the exploitation of Professor Bell's invention. This was succeeded by the National Bell Telephone Company, which, in 1878, consolidated with the telephone interests in New England into the American Bell Telephone Company. Later this company was reorganized into the present American Telephone and Telegraph Company, Mr. Vail becoming general manager. In 1889 Mr. Vail left the telephone business and for more than ten years thereafter was in Europe and South America, building up electric railway and electric lighting companies. He changed over the street railways of Buenos Aires from horse to electric traction, and until recently had large interests in South America. Mr. Vail retained a large interest in the telephone business, and for the past four years has been a member of the board of directors of the American Telephone and Telegraph Company.

Mr. Vail has always been a commanding figure in the management of large affairs. He was instrumental, through the years of the creative and formulative period in the organization of the parent Bell company, in establishing licensee telephone companies, the greater number of which to-day are still in the same close relation with the parent company as they were originally. He is a man of wide experience and great energy, and brings to this position abilities which will carry forward and develop the service and growth of this rapidly expanding organization.

Long Acre Electric Light and Power Company Wins Subway Suit in Court of Appeals.

The plans of the Long Acre Electric Light and Power Company, which has announced its purpose of establishing a competitive system of generating and distributing current for light and power in New York city, have been considerably helped by the decision handed down on Tuesday, April 30, in the Court of Appeals, confirming the company's right to lay its electric cables in the subways of the Consolidated Telegraph and Electrical Subway Company. The decision affirms, with costs, the decision of the lower courts.

Six months ago the Long Acre company applied to the Consolidated company for space in its conduits. The application was denied, and a mandamus was secured from the Supreme Court. The subway company appealed to the Appellate Division, and the decision of Justice Dowling in the Supreme Court was affirmed by a divided court. The subway company claimed that the Long Acre company did not have a valid franchise. The Long Acre company, on the other hand, claimed that it owned a franchise from the board of aldermen giving it power to lay its conduits and sell electricity for light and power.

A. J. Dittenhoefer, of counsel for the Manhattan Transit Company, which owns the Long Acre Electric Light and Power Company, has announced that permission to open the subways will be sought at once from the commissioner of water supply, gas and electricity. As soon as this permission is granted the laying of wires will be begun.

The Manhattan Transit Company also has a franchise for building a tunnel from Manhattan to Brooklyn, and is empowered by its charter to run electric motors, either passenger or freight, throughout the state. It has been asserted that the company would construct a tunnel from a point about Broadway and Fulton street across to the borough hall in Brooklyn.

The men who control the Manhattan Transit Company and the Long Acre Electric Light and Power Company are John C. Sheehan, Edgar Van Etten, William H. Lamprecht, G. Tracy Rogers, William J. Clark and William Harris.

New York Electrical Society.

The New York Electrical Society held its 267th meeting at the power station of the Interborough Rapid Transit Company, Fifty-ninth street and Eleventh avenue, New York city, Wednesday, April 24. Over 500 of the members and friends of the society availed themselves of the opportunity of seeing this plant. After a short address by Henry G. Stott, superintendent of motive power, the visitors were escorted by a corps of attendants over the station. A feature of the meeting which was highly appreciated was the presentation to each member by the Interborough company of a pamphlet containing the principal dimensions and data of the plant. This, the first "visiting meeting" this year, was one of the most successful gatherings of the season.

The following members were elected: Edward C. Titus, Guy H. Lippitt, Patrick J. Shelley, H. R. Swartley, Jr., James B. McCord, L. K. Comstock, A. F. Rolf, J. H. Pardee, W. E. Barrett, James P. Quigley, Eugene E. Higgins, Leon D. Collins, W. V. Dolan, Dwight K. Hall, M. Clark, Herbert Lloyd, Stephen L. Tabor, W. W. Freeman, R. E. Farmer, Richard W. Meade, George L. Collison, Frank Stout, E. N. Chilson, K. B. Thornton, Norman L. Folger, Arthur W. Chapp, Ellis L. Phillips, Emile A. Causse, Elmer A. Sperry and L. R. Nutting.

The Frank Presbrey Advertising Agency.

The Frank Presbrey Advertising Agency of New York, has been incorporated with a capital of $250,000. Frank Presbrey is one of the best-known advertising managers in the country. His company lists among its clients some of the largest manufacturers in the electrical and allied industries. In the new company, with Mr. Presbrey, H. H. Porter and O. H. Blackman, both of whom are well known and greatly esteemed, are directors.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

The Carbonnelle Telautographeur.

An interesting summary is given here by Ch. Mehen of the various systems which have been proposed for telegraphing pictures and writing, usually classified under the term "telautography." One of the systems described, that due to Carbonnelle, is new. In it the drawing or writing to be transmitted is engraved at the receiving station on wax or other soft material. The transmitter operates much as does the stylus and diaphragm of a phonograph, a small stylus, attached to a suitable telephone diaphragm, is traversed over the surface on which the message is written or the picture drawn. This message is either in relief or depressed. The vibrations thus set up are passed along the transmitting line to a similar diaphragm at the receiving station, but here the stylus is replaced by a burin, which reproduces the original copy in some material such as tinfoil. The system is said to work well, and illustrations are given of photographs and messages reproduced in this way.—*Translated and abstracted from Electro (Brussels), March.*

Mechanical Actions of Currents in Electric Conductors.

An interesting study is given by Paul Bary of the mechanical actions set up in liquid and gaseous conductors, due to the passage of a current through them. If two bodies of mercury be connected by a narrow channel, also filled with mercury, and a heavy current be sent through, a constriction of the mercury in the channel occurs near the centre, and if the current be strong enough, the column is finally broken and the circuit opened. The action is thought to be due to the force or pressure set up on the metallic conductor, due to the tendency of the elementary current lines to draw closer together. Such a device might be used as an interrupter, but its action would not be under control, and be irregular. However, if a vessel of mercury be arranged so that a slender stream falls from it into a receiving vessel, this falling column will act as an interrupter, if a large enough current be passed through it. The action here is the same as before, and it is thought that the Caldwell interrupter, which consists of two electrodes submerged in a conducting fluid, one of these being enclosed in a glass tube pierced by a small opening only, depends for its action upon the same effect. Such an apparatus sets up a rapid interruption of the current. Usually the action has been attributed to the production of heat by the current in passing through the narrow portion of the path, but this explanation is not accepted by the author. The same phenomena may be made use of to pulverize metals, for at the instant the circuit is broken part of the metallic conductor is thrown out in the form of a spray. If, then, the melting pot be arranged so that the molten liquid will fall from it in a slender column, through which a heavy current may be passed, and a current of gas be directed against this falling column, the latter will be broken up by the current, and the spray of metal thus formed carried away by the gas. In this way the author has pulverized lead, copper, aluminum, silver, and other metals. A study then is given of the convection currents which are set up in the column of conducting fluid before the break occurs. In general there will be slight elevations of the surface of the fluid where the column joins the two larger bodies of metal, and the metal will flow from these points towards the lower point in the centre and backward along the bottom of the column. If an alternating current be sent through such an arrangement, waves are set up, which, under favorable conditions, become stationary, the surface of the fluid becoming undulated. Knowing the frequency of the current, it is possible, by means of this phenomenon, to measure the rate of propagation of waves in the conducting fluid. The author then considers the electromotive forces which are set up in fluid conductors, due to the passage of a current along them. Due to the magnetic field surrounding the conductor and to the movement of the latter, electromotive forces directed from the centre outward will be created. These ideas are then applied to the conduction of electricity through gases, and it is thought that the explanation offered for the interruption of a metallic conductor is satisfactory for explaining the behavior of the singing arc. In rarefied gases marked effects should be observed, on account of the mobility of the conducting particles; and this accounts for the striking phenomena observed, due to the passage of current through such devices. The author concludes that this effect—that is, the tendency of the conductor to contract when a current is passed through it—is insensible in solid conductors, because of the cohesion of the molecules. It occurs in liquid conductors, as has been shown, and here the same phenomenon is observed whether the current be alternating or continuous. Due to the greater mobility of gases, the same effect occurs in them with much smaller current densities, and the effect is still more notable if the gas be rarefied.—*Translated and abstracted from L'Éclairage Electrique (Paris), April 17.*

Electrical Equipment of a Buenos Aires Granary.

A description is given here of the electrical equipment of a large grain-handling plant in Buenos Aires, Argentine Republic. This includes docks and grain elevators. The plant consists of two blocks of buildings, occupying an area of about 120,000 square feet. The first block is composed of three large embarkation or shipping warehouses, each one provided with two elevator towers for the deposit of wheat in bulk, one elevator for the storing and internal distribution of grain, and discharging chutes for loading vessels. The second block is behind the first, and separated from it by a street. The central portion of this group of buildings consists of grain storage bins with the necessary elevators. There are three shipping sheds fronting the dock, each with a receiving capacity of 35,000 tons of wheat in bags, besides storage for 10,000 tons in bulk. The rear buildings have a storage capacity of 35,000 tons of wheat in bags and 21,000 tons in bulk, giving a total capacity of 110,000 tons. The buildings are provided with all modern useful machines for handling and cleaning wheat, which are worked by electric power. It can handle 2,400 tons in bulk per hour and discharge 1,200 tons, besides receiving and embarking 500 tons in bags per

hour. The power plant for this installation is driven by a gas engine operating on Dowson gas. There are four engine units, each rated at 250 horse-power, and two auxiliary engines and air-compressors, used for starting the large engines. The generators are direct-connected and placed beside the heavy engine flywheel. They are designed to give 350 amperes at 525 volts. There is also a 250-cell storage battery for lighting purposes. The motors are uniformly 500-volt, compound-wound machines with double-gauze ventilation in the end plates. They drive by means of rawhide pinions. There are sixteen elevators, each of 150 tons capacity per hour, at a speed of 600 feet per minute, driven by means of thirty-two-horse-power motors; forty conveyer belts, including two thirty-inch bridge conveyers, each with a capacity of 300 tons per hour, which are driven by twenty-two-horse-power motors; four roof, four sub-basement and two bridge belts, each operated by a thirteen-horse-power motor; five subway belts driven by eight-horse-power motors, five housing belts driven by ten-horse-power motors, and two longitudinal belts driven by twelve-horse-power motors. There are twelve additional belts driven by motors rated from ten to fifteen horse-power, and five driven by small two-horse-power motors. In addition there are two machine shovels driven by six-horse-power motors; a marine elevator for lifting barges to the dock, driven by a thirty-two-horse-power motor; thirteen one-ton hoists operated by eight-horse-power motors, and eight yard capstans designed to haul 300 tons at a speed of fifty feet per minute, which are driven by twenty-horse-power motors.—*Abstracted from the Electrical Review (London), April 12.*

On the Magnetic Behavior of Certain Nickel Alloys.

There are two classes of alloys of the ferro-magnetic metals which are of particular importance—the steels and the alloys used in the construction of resistances. Only recently has it been realized that the properties which render steel so universally useful are very closely connected with its magnetic characteristics. Heretofore the hardening of steel by sudden cooling was explained by supposing that in the rapid fall of temperature strains were set up in the metal which caused its hardness; or the hardness was accounted for by the presence of small particles of very hard carbon or of carbide. While this latter explanation may be true in part, it is not sufficient to account for the phenomena of the tempering of steel. Electrolytic iron is very hard when deposited. It also behaves like hard steel magnetically, but after annealing it is soft both mechanically and magnetically, like Norway iron. Neither sudden cooling nor temper-carbon plays any part in this case. Moreover, it is difficult to see why other metals should not be hardened in the same manner if these explanations be true. E. V. Hill here gives the results of an examination into the behavior of certain nickel alloys, in an attempt to determine how the hardness of the metal is varied by the percentage of metals in the alloy. He first calls attention to the non-expansive alloy containing thirty-four per cent of nickel, the coefficient of expansion of which is only 0.000001. This material should be useful for clock pendulums and many scientific instruments. It takes a good polish and resists corrosion as well as nickel. Steels containing from forty to fifty per cent of nickel have about the same coefficient of expansion as glass, and have already begun to replace platinum in the manufacture of incandescent lamps in France. The alloys used for resistances generally contain nickel, and the greater part of them are unmagnetic. The resistances are higher than those of pure metals, and the temperature coefficient is lower. If iron containing carbon be cooled, a marked evolution of heat takes place at 850 degrees centigrade, and at 760 degrees centigrade, indicating some transformation in the metal itself. Osmond based his allotropic theory of the magnetic metals upon these phenomena. If any substances other than carbon could be added to the iron, which prevent its transformation, we should expect to be able to alter the properties of the alloy in a way depending not only upon the nature of the added substance, but upon the amount of the two allotropic forms produced at the critical temperatures. It has been found that such substances reduce the tempe a ture of transformation. The most ready analogy to the depression of the temperature of magnetic transformation of iron and nickel by other metals alloyed with them is the lowering of the freezing point of a liquid by dissolved substances, which is known as the law of Van't Hoff. The work described here was undertaken to test the applicability of this formula to the case in hand. It must be remembered in attempting this that neither metal separates from the other at the point of transformation, which is shown to be true by microscopic examination. Nickel was chosen for these experiments rather than iron, because of its low temperature of transformation. Nickel and copper may be alloyed in all proportions, and such alloys are easily obtained. Four specimens were employed in the form of wires two millimetres in diameter, and containing four, eight, twenty and forty per cent of copper. To obtain the relation between induction and temperature, a secondary coil of bare copper wire was wound around a glass tube, over which was placed a primary coil, and over both of these a heat coil of nickeline wire. The standard to be examined, together with a standard mercury thermometer, was then placed in the glass tube, and the whole apparatus packed with asbestos as heat insulation. Measurements were thus made to determine the induction of the various samples of wire at different temperatures. It was found that when a given temperature is reached, the corresponding magnetic condition establishes itself without appreciable lag. The loss of susceptibility does not occur suddenly, but when it has fallen to a small fraction of its original value the decrease becomes slower. This enables the temperature to be determined within five degrees. The results of these tests show that the depression of the point of transformation is nearly proportional to the amount of copper in the alloy. Alloys of nickel and tin were then tested, and here also the depression of the transformation point was found to be proportional to the amount of tin. Attention is called to the work of Allen and Day with alloys of nickel and silver, in which the temperature of transformation was found to be fixed, irrespective of the amount of silver. Levin also experimented with nickel and gold alloys, and found the temperature of transformation independent of the amount of gold. Alloys containing equal parts of nickel and gold and of nickel and platinum were found by Lampadius to be as permeable as pure nickel. Osmond found the transformation point of nickel-iron alloys to rise with the amount of iron until the latter reaches thirty per cent, when it falls again. In nickel-chromium and nickel-manganese alloys the point of transformation is not proportional to the amount of chromium or manganese.—*Abstracted from the Physical Review (Lancaster), April.*

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

EDITED BY CHARLES A. PARKER.

Selection of Solicitors.

"I'd rather have ten picked men who fight like heroes than fifty who fight half-heartedly," said a famous Indian fighter.

The same quotation could be well applied by many central station managers in the selection of their sales force.

Too many managers have an idea that any sort of a solicitor is good enough, as long as he will work cheap, and land a contract occasionally.

All a mistake.

You can hitch any old boneyard to a wagon, but it takes a "live" horse to draw a load and get there.

The efficiency of your salesmen is only secondary to the efficiency of your service. Your success hinges not on one or the other, but on both. For given efficient service and an efficient, hard-working corps of salesmen, who shall say to what heights your company can not attain? Therefore, the selection of solicitors is a mighty vital and important one to central station managers.

A central-station solicitor was recently calling upon a merchant, whom he was trying to interest in an electric sign, when the mail man entered and placed on the merchant's desk one of the lighting company's advertisements. The merchant threw up his hands and exclaimed, "Oh, what's the use!" This goes to show how direct-by-mail advertising backs up the solicitor.

The trouble is, this matter is usually not given the thought and attention it deserves. Too many managers make a practice of using their contract department as a sort of catch-all for applicants for positions, who have no claim for a job outside of some political or personal pull with the officers. The quicker this is cut out the better. Solicitors should be chosen who are capable of representing you. Ability, not favor, should be their equipment and qualification for the position.

If you have to make a place for some friend or relative of the officers, don't put him on the soliciting force, unless he has real ability in that line. A poor solicitor can do the company more harm than a dozen good ones can counteract. Remember, the solicitor is, to all intents and purposes, the company. He represents it, and what he says is regarded by the people as being the words of the company.

How important it is, then, to have someone who can represent your company right! Someone with the ability to not only sell current, but a man who can create a friendly feeling for your company wherever he solicits. For when all's said and done, public sentiment goes a long way toward the making or unmaking of any public utility corporation. Hence, tactful solicitors are a good asset when public opinion is considered.

Coming right down to the selection of solicitors, to my mind there are a few necessary requirements demanded in the successful seller of current.

First and foremost, he should have a practical knowledge of his business, for how can he expect to convince or convert a man, unless he knows what he is talking about? He should have a pleasing personality and address. He should have enthusiasm, tact and stick-to-it-iveness. He should be honest, patient and self-reliant. He should be able to make friends in and out of business. He should be very systematic in his methods of uncovering prospects and following them up. He should be very explicit with his facts and figures in explaining to every customer the advantages of electricity, as applied to their particular needs. He should not misrepresent.

There may be a few other qualities, of course, but if a man possesses most of those enumerated above, he has the making of a good solicitor in him.

He should have at least knowledge, enthusiasm and honesty, for with these three fundamentals as a basis, he can cultivate the rest.

As the success or failure of any business or profession hinges largely on the enthusiasm of those who guide it, enthusiasm, therefore, is necessary to the successful salesman. It stimulates him to tireless activity, and he works with an energy and zeal that accomplishes its purpose.

And as honesty is the best policy in any undertaking, it is also best in salesmanship, for a contract obtained by questionable methods and misrepresentation does the company more harm than good.

Brightest and Best
A well lighted store is the Mecca to a woman shopping. She delights in a store where she can match fabrics easily, in buying silks, laces, or any other article she wants to see what she is purchasing.
A bargain under bright light is twice a bargain. If it is a bargain in the store and continues to be a bargain when at home she examines it closely.
The best light—electric light—pays big dividends to every merchant. Try it and prove it.
Buffalo General Electric Co.

A reproduction of one of the folders recently sent out to the merchants of Buffalo, N. Y., by the Buffalo General Electric Company, showing same ready to mail and also opened up. A large number of such attractive folders are preserved by business men after they have absorbed the arguments contained in them, or mailed the postal enclosed, for further information.

Practical knowledge of the business is absolutely necessary, for, fortified by knowledge, enthusiasm results in aggressiveness and persistency.

The solicitor who thoroughly knows his business feels a confidence and self-reliance that enables him to cope with any opposition, and adds force to his arguments.

A careful looking around your town will probably reveal some bright, ambitious fellows, who, with a little coaching, may develop into first-class solicitors. If

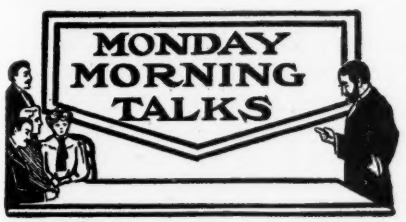
you can get a natural-born salesman, so much the better.

It is often a good idea to take a man who has unquestioned selling ability and break him into the business. Don't expect too much of such a man at the start, however. Give him your support and a hand occasionally. Remember, he has to familiarize himself with his line before he can make good at it. Encourage him, therefore, all you can.

A few little heart-to-heart talks with him on the subject will soon give you an idea of the points on which he needs coaching, and if the right stuff is in him, he'll develop rapidly and turn out to be a profitable investment.

If managers would only give the selection of solicitors the same care and thought they give to the purchasing of equipment, they would not have so much trouble gathering an efficient sales force together.

Never lose sight of the fact that a good solicitor is worth more than his salary, for outside of the actual business he turns in, the good will and friendship he creates and builds up for your company is, in a way, priceless.



Under this general heading we shall present to our readers a series of bright, stimulating talks to solicitors, which, we believe, will prove valuable to managers of new-business departments in suggesting points which they can profitably bring out in their occasional meetings with the company's representatives.

We shall gratefully accept contributions and suggestions from any of our readers.

Why is it that some men attract business, customers, clients or patients as naturally as the magnet attracts steel?

It's the power to please, boys.

You may call it "luck" or anything else you like, but when you sift the matter right down to the bottom, you'll find these men have an attractive personality that wins all hearts.

I tell you fellows, the power to please is a tremendous asset to the solicitor.

And it's cultivatable.

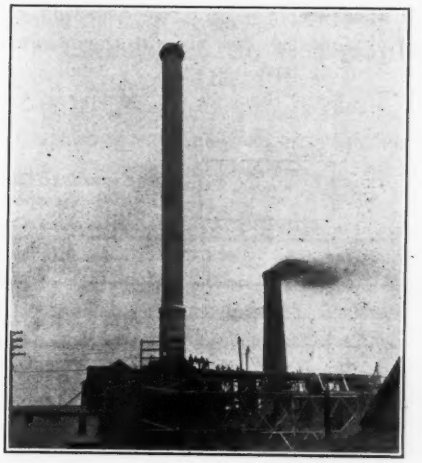
You can not over-estimate the importance of cultivating a pleasing and charming manner, and those personal qualities that draw people to you.

As one philosopher says: "Keep pleasant and agreeable till ten o'clock in the morning and the rest of the day will take care of itself."

The power to please is often a substitute for a large amount of work.

It's simply a trait of human nature to deal with people you like, and the solicitor whose dress, actions, talk, etc., are pleasing, is always sure of an audience, and usually closes a contract with half the effort required by a less pleasant worker.

Now don't get the idea that you've got to be a regular Beau Brummel or a candidate for the beauty prize to have the power to please and attract people to you.



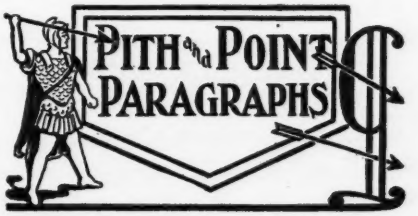
A photograph taken of the Evansville Gas and Electric Company's new smokestack, while a couple were being married on the top. The management of the company offered a prize of $200 for the young man and woman who were "game" enough to have their wedding ceremony performed "up in the air," 220 feet above the earth.

Lincoln had the reputation of being a very homely man, yet he instinctively attracted all people towards him by his kind and pleasing manner.

And don't imagine that all magnetic people are born that way.

They simply think, cultivate and train themselves to be pleasant and agreeable till it becomes second nature to them.

So I say, fellows, cultivate the art of pleasing, for the solicitor who always attracts and never repels ought to be pretty nearly successful in his calling.



Under this heading we shall, from week to week, present to our readers a little series of inspirational aphorisms (original, aboriginal and selected), which will, we believe, prove stimulating and suggestive to those who are interested directly or indirectly in the sale of central station current.

There's no time to begin like the present.

You'll never get round-shouldered carrying the money you make by "contemplating" doing things.

Putting off an easy thing makes it hard; putting off a difficult thing makes it impossible.

The road of prejudice is the one most commonly traveled by the human multitude.

Stones are only thrown at fruit-bearing trees.

"Plan your work and work your plan"—that's the essence of concentration.

An opportunity isn't an opportunity unless it's seized upon.

Everything comes to the solicitor who lets the other fellow do the waiting.

A solicitor or manager must keep his mouth open a long time before a roasted pigeon flies into it.

Any old dachshund may start a hare, but it takes a greyhound to catch him.

He who finds fault is very apt to be thinking about signing a contract.

It will be our endeavor, from week to week, to present in this department brief notices of activities among the central stations, as gathered from men who are in the field and, consequently, in close touch with the progress of the new-business idea and its acceptance by central station managers. Contributions to this department are solicited, and will be received with much appreciation by the editor.

If you are doing something a little better than or different from the other fellows, and think it would make interesting reading to ELECTRICAL REVIEW readers, send in your schemes and plans. They will be gladly received.

Address all communications to Charles A. Parker, care of the ELECTRICAL REVIEW.

We are pleased to note that an extremely healthy condition of affairs and a hustling new-business department exists in the thriving town of Evansville, Ind.

The Evansville Gas and Electric Company is the company which holds sway, and both the gas and electric ends of its business have enjoyed a very fine growth in the past year, the electrical interests being especially well taken care of with progressive new-business methods.

W. B. McDonald, the manager of the company, is a man of sterling business ability, which is backed up with a thorough knowledge of the electrical and gas

business. He has the right idea for the upbuilding of his company's business and the sale of more current.

Mr. Tills, formerly with the North Shore Electric Company, of Oak Park, Ill., is now contract agent and head of the new-business department. He is one of the most hustling new-business men in the country and has won his spurs as a strenuous business-getter, and he's "still going."

He has plans and schemes—good, practical ones at that—"up his sleeve," which are worth knowing about.

Central station managers will find it profitable to cultivate this gentleman's acquaintance. He is simply "doing things" in the way of getting new business.

Some of the less aggressive men who have charge of this department of their company's business would stop, look and listen if they knew what he had accomplished.

Enlisting the school-children's aid in selling gas and electricity is one of his many successful feats.

He has made "cook with gas" and "light with electricity" household words in Evansville by novel yet sensible methods—public methods.

His system of keeping track of the work done by solicitors, contracts closed, reports, etc., is the best of its kind. He and every solicitor know exactly where they are at every minute. All classes of business in every part of the city are kept in close touch with by this complete system.

Mr. Tills is close to his men, and personally supervises their daily work, meeting them each morning to go over the ground thoroughly before sending them out.

The daily reports of the solicitors' records, the exact time the solicitor arrives in a district, the business secured during the day, those who are good prospects, calls made where no business can be secured, the nature of the business solicited, and the expense account of the solicitor during the day.

One of the best things I have yet heard of in many a day is Mr. Tills' scheme or plan of automatically keeping the solicitors calling on prospects.

The solicitors, being partly on salary and partly on commission, make this plan possible.

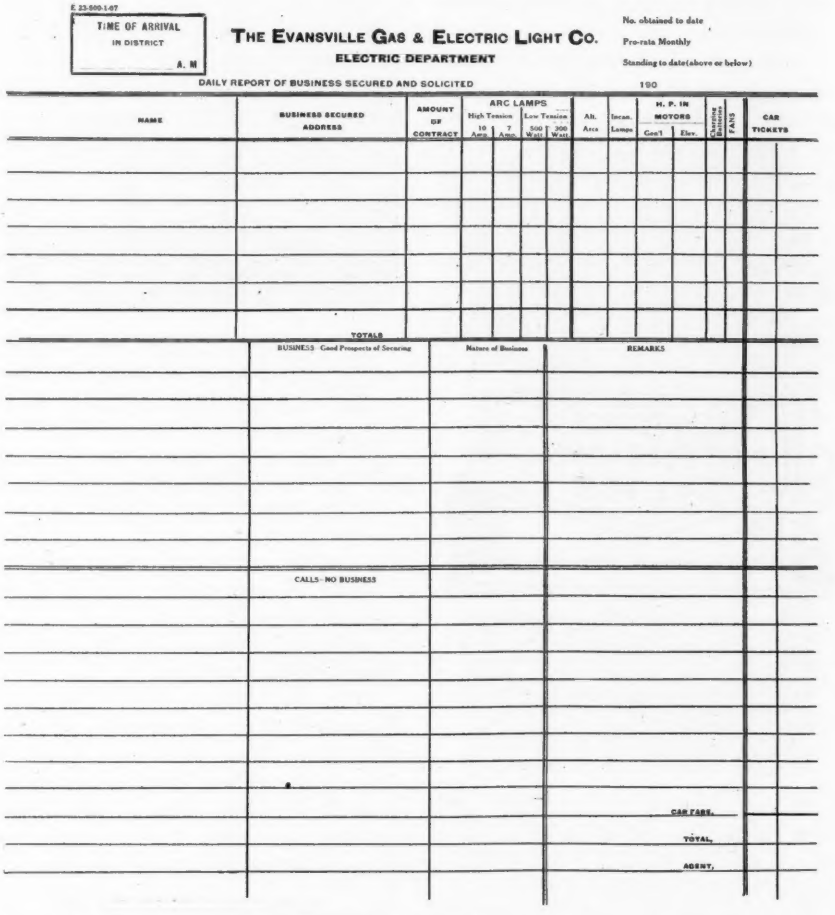
In case a solicitor fails to call on a prospect within the prescribed time, and the prospect comes in and does business with the office, the sale is credited to the office and not the solicitor.

If, however, the prospect comes in and does business with the office, and it is found that the solicitor did call at the time marked on his follow-up system, the solicitor gets the credit and not the office.

This keeps the men calling with great regularity on all their possible prospects.

In addition to this, a scout solicitor is constantly kept working in all territory. Any business that he obtains is held up to the regular solicitor in the field as proof that he has been negligent and overlooking business.

This keeps them on the *qui vive* at all times, and continually hustling for business.



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TIME OF ARRIVAL IN DISTRICT A. M.

THE EVANSVILLE GAS & ELECTRIC LIGHT CO.
ELECTRIC DEPARTMENT

No. obtained to date
Pro-rata Monthly
Standing to date(above or below)

DAILY REPORT OF BUSINESS SECURED AND SOLICITED 190

NAME	BUSINESS SECURED ADDRESS	AMOUNT OF CONTRACT	ARC LAMPS High Tension 10 Amp.	ARC LAMPS High Tension 7 Amp.	ARC LAMPS Low Tension 600 Watt	ARC LAMPS Low Tension 300 Watt	Alt. Arcs	Incan. Lamps	H. P. IN MOTORS Gen'l	H. P. IN MOTORS Elev.	Cleaning Business	FANS	CAR TICKETS	
	TOTALS													

BUSINESS Good Prospects of Securing	Nature of Business	REMARKS		
CALLS—NO BUSINESS				
		CAR FARE,		
		TOTAL,		
		AGENT,		

A handy, comprehensive and systematic blank for recording the daily reports of solicitors.

Another thing Mr. Tills believes in is the securing of good solicitors and paying them well. He says a cheap man is not even worth a low salary, and in the end is a detriment to the company.

Having both gas and electricity, this company works the changes as the seasons come and go, and keep things moving all the year around.

For instance, in February and March, a big lot of gas stoves were sold and installed. Now as summer comes around, electric light, flat-irons, fans, etc., are being pushed to the limit.

The Evansville Gas and Electric Company is another firm that believe in concentrating their efforts when it comes to advertising.

During the year 1906 this company carried on a most successful direct-by-mail advertising campaign on store and store-window lighting.

The advertising was in the form of attractive, handsomely printed and well-illustrated booklets, folders, mailing cards, etc. Each and every piece of this advertising was filled full of this one subject—store and store-window lighting, and its strong arguments, examples and figures kept the business men of Evansville in a white-heat state of enthusiasm on these propositions, while the solicitors were around gathering in the contracts.

This year, Mr. Tills has decided to push the power end of his company's business.

He is sending out an equally strong, if not stronger, series of direct-by-mail advertising than that which he used on merchants.

This power advertising is built on hard

business lines and radiates enough sound arguments to meet Mr. Power User on business grounds, and sinks its story deep into him without showing that its mission is surely to convince him—whether against his good judgment or not.

It talks along with him and never shows a weak spot. For it is written that if a piece of advertising falls down in one single point, the receiver will make the most of it, and will feel suspicious of everything else it says.

But this company's advertising keeps up to the high-water mark from beginning to "finis."

The appearance and general get-up of all its advertising seems to indicate that it believes Darwin's theory of the "sur-

Measure on your floor how much room a motor would take
Electric Power is the most economical power—it will invariably increase shop out-put, and reduce cost of production. Substitute the Electric Motor for any other form of power for driving machinery and you eliminate all unnecessary items of expense.
Electric Power is absolutely the most saving power.
Individual Motor Equipment is the most satisfactory method of applying Electric Power. Individual Motors secure independent control of each machine, economy of floor space, greater steadiness of power and reduced transmission losses. Individual Motor Equipment eliminates line shafting, belting and hangers, leaves free room overhead, permits lighter building construction and results in increased cleanliness, reduced fire risk and greatly improved light.
Next time you add a machine to your plant, give the Individual Motor a trial—Secure Independent control of the machine and highest economy in operation—A test will demonstrate, by saving many dollars for you, that Individual Motor Equipment is the most economical power.
A test of the Individual Motor will prove to you quicker than words the advisability of having a plant equipped throughout with Individual Motors.
Telephone and our representative will call and explain more in detail.
Evansville Gas & Electric Light Co.
EVANSVILLE, IND.
'Phone 1150
120 Main St.

A two-colored mailing card which forms part of an excellent direct-by-mail advertising service which the Evansville Gas and Electric Company, of Evansville, Ind., is using to increase a sale of current among power users. Note the suggestiveness and attractiveness of the design, and the fine typographical arrangement of the card as a whole.

vival of the fittest" holds good in advertising as it does in man. At any rate it will receive better attention than if it were of the tawdry, careless, haphazard kind.

Some of it may be permanently waste-basket proof. It is at least temporarily so, because the recipient, on account of its good appearance, will lay it aside to look over again when he gets time.

This company is also a believer in good newspaper advertising, and it makes the best use of the space it buys by inserting well-designed and strongly-written advertisements.

Last year this aggressive company hit upon the unique and attention-compelling advertisement of having a young couple married on top of their smokestack, which created almost world-wide comment.

The account of this novel method of advertising was copied in a large number of newspapers throughout the country, and was one of the best advertisements the city of Evansville ever had.

"Lincoln in the Telegraph Office."

A series of articles which will be appreciated by every American will begin in the May *Century,* entitled "Lincoln in the Telegraph Office." These articles have been prepared by David Homer Bates, and will be fully illustrated. During the four years of the Civil War Mr. Lincoln spent more of his waking hours in the War Department telegraph office than in any other place except the White House. Mr. Bates, who was the manager of the office and cipher operator during these eventful years, tells the story, which contains much that is new regarding the leaders of the war, and sheds a new and interesting light on the great figure of Lincoln.

Kentucky Independent Telephone Association.

The Kentucky Independent Telephone Association held its annual meeting at Louisville, Ky., on April 16. The following officers were elected: president, M. B. Overly, Louisville; secretary, W. G. Turpin, Henderson; treasurer, J. W. Chambers, Winchester. Executive committee: R. T. Hickman, Henderson; B. L. Pendleton, Winchester; Edwin Matthews, Maysville; P. S. Pogue, Louisville.

The following delegates were appointed for the national convention: George Shanklin, Lexington; H. P. McChord, Hopkinsville.

Comparison of Methods of Office Illumination.

In the issue of the ELECTRICAL REVIEW for April 27, an abstract of the very interesting paper by Edward A. Norman, entitled "Comparison of Methods of Office Illumination," and read before the March 8 meeting of the Illuminating Engineering Society, was published. It is a matter of sincere regret that an accident in the make-up eliminated the last paragraph in the paper. In this paragraph credit was given to the Electrical Testing Laboratories, New York city, where the tests described in the paper were carried out.

Electric Power in Mexico.

A number of electric power projects, says the *Wall Street Journal,* are on foot in northern and western Mexico. It is stated that there are a number of waterfalls in the Sierra Madre range bordering the western coast which afford ideal sites for hydroelectric plants, and that the building of railroads through that region will lead to the early development of these power enterprises.

Idalecio Trevino, of Monterey, and associates, are arranging to install an electric power plant on the Escondido river in the state of Coahuila, and the power will be transmitted to industries in that section.

A. C. Nash, general manager of the company which has been organized to build a system of electric street railway in the city of Chihuahua and to build interurban lines leading out of that city, has returned from the United States, where he closed contracts for the purchase of enough steel rails to lay ten miles of track. He is now in the market for 30,000 crossties. Enrique Creel, Mexican Ambassador to the United States, is at the head of one company. The same interests own the steam railroad which runs from Chihuahua to Santa Eulalia. This line will be converted into electric transit and made a part of the general system.

The Parral Power and Reduction Company is preparing to construct an electric street railway system in the city of Parral. R. B. Davis, formerly superintendent of construction and permanent way department of the Mexican Tramways Company, Limited, of Mexico City, has just completed an estimate of the cost of the proposed system at Parral.

L. B. Speyer & Company, of Mexico City, have signed a contract with Governor Tomas Anzar y Cano, of the state of Campeche and the city council of Campeche for the installation and operation of an electric light and power plant for Campeche. A subsidiary company will be organized to carry out the terms of the concession. L. B. Speyer & Company are bankers and will finance the enterprise. The contract calls for furnishing 2,000 lights at $2 per month, and sixty arc lights and 200 lamps of fifty-candle power for the government, at a price of $18,500 annually, making a total of $66,500 annually that is guaranteed, not counting any income that may be received on motive power and extra lights. Campeche is a city of much wealth. On account of its remote location the opportunity for an electric light and power plant there was a long time in being discovered.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Reducing the Heat Losses in Armatures.

The American Engine Company, Bound Brook, N. J., has adopted an interesting construction of its dynamo and motor armatures to limit the losses occurring through the heating of the armature coils. The armatures are of the double-conductor, drum-wound type. Solid-bar copper strips are used, wrapped with cotton thread, subsequently impregnated with insulating compound. This design allows the use of large conductors. This form of construction has not been generally adopted because of the cost of hand labor required to wind the insulation on the bar after it has been bent and formed, and because the cotton insulation would break in bending the bar.

FIG. 1.—BAR-WOUND ARMATURE COIL.

FIG. 2.—HARD FIBRE RETAINING WEDGE.

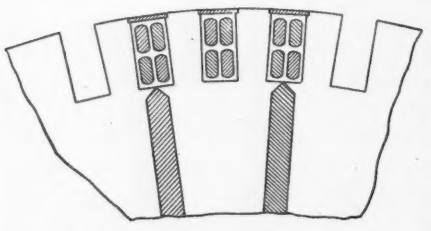


FIG. 4.—ARMATURE CONSTRUCTION.

Fig. 1 shows the form of bar copper conductor used in the American Engine Company's armatures. This form has been made possible by the development of special machinery for handling the double-cotton-covered bar edgewise without injuring the insulation. The armature, of the ordinary laminated type, is provided with a deep gap or ventilating channel midway in its length by blocking apart each set of laminations to a distance of one-half inch to one and one-quarter inches, according to the size of the machine.

To hold the coils in place, little bridges of tough fibre board of the form shown in Fig. 2 are driven into the slots over the coils. The shoulders on these fibre wedges engage the teeth of the core on each side of the air space, maintaining a proper distance between each section of laminations. Steel band wires, which are used to retain the coils in their slots against centrifugal action, secure the ends of these fibre covers. Fig. 3 shows the completed armature.

FIG. 3.—COMPLETED ARMATURE.

Each set of laminations is held in place and the air space maintained by distance pieces of hard wood wedged in between the end laminations of each section. This construction is shown in Fig. 4. In this way an open passage is left to the annular cylindrical air space, which runs the entire length of the armature between the armature shaft and the internal spider surface. This longitudinal air space connects with the circle of oblong spaces arranged spoke fashion about the core, and creates a ventilating circulation at the middle of the armature, where usually the conductors are farthest removed from the cooling air. When the armature revolves, air is thrown radially from these air spaces, being replaced by air drawn from the spider passage. It is announced that the working temperature is kept very low, and upon careful tests this has been shown to be forty per cent less than the theoretical calculation indicated it should be. A feature of this form of ventilation is that the velocity of the air current effectually prevents the accumulation of dust in the armature.

A New Portable Combination Meter.

The unique combination of a voltmeter, ammeter, wattmeter and horse-power meter in one instrument is accomplished in the "Victor" combination meter, manufactured by the H. W. Johns-Manville Company, New York city. This instrument was first placed on the market somewhat over a year ago, and, from the large number of inquiries and orders received, it has evidently found ready acceptance.

It was first designed for switchboard use in central stations, and the success of the instrument for this purpose has recently led to the placing on the market of a portable form for general electrical testing, an illustration of which appears below.

The "Victor" meter consists of two separate and complete instruments in a single case, the one giving readings in volts and the other in amperes. The third and fourth readings are obtained on a scale plotted at the centre of the dial,

"VICTOR" COMBINATION METER.

giving the product, or power consumption, in watts or kilowatts and horse-power. These readings are taken at the points of intersection of the two indicators. The power scale is calibrated in "watts" or

"kilowatts" on one side and "horse-power" on the other.

The convenience of having in one instrument a portable meter giving readings in volts, amperes, watts and horse-power is readily appreciated at a glance, as this meter is adapted for rapid testing in the laboratory, while for field work it is especially adaptable. It has been found suitable also for taking readings on electric cars, electric elevators, etc.

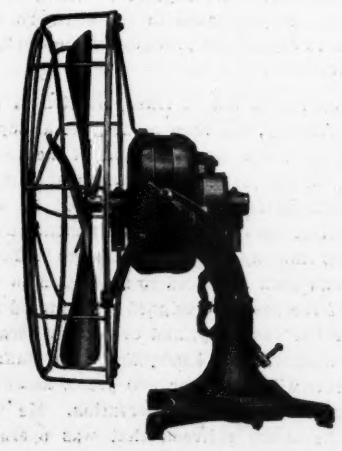
If desired, multiple shunts and extra multipliers will be furnished in connection with the volt and ampere scales for additional readings, and a table, containing the multiplying factor to be used with these various combinations, when reading the central scale.

The workmanship and materials used in the manufacture of the "Victor" meter are of the highest class. The calibrations are carefully and accurately made, and the instrument is reliable and permanent.

Western Electric Alternating-Current Fan Motors.

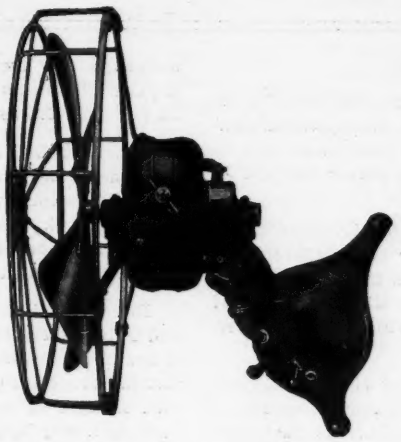
A new line of alternating-current fan motors has been placed on the market by the Western Electric Company, Chicago, Ill. Starting difficulties are eliminated by using a specially constructed commutator. The company guarantees this motor to start when the current is turned on, the same as with a regular series, direct-current fan motor.

Another advantage of this motor is its "Universal" feature, which allows it to be used either as a desk or bracket fan, and the change from one to the other can be made in a minute. This is called the "Two-in-One" type, because it really makes one type of fan serve two purposes. An ingenious diagonal joint in the standard makes this change possible, and a glance at the illustrations will make this clear.



Western Electric Alternating-Current Desk Fan Motor.

All the working parts of the motor are completely enclosed, so that it is impossible to clog up the machinery with dust or dirt.

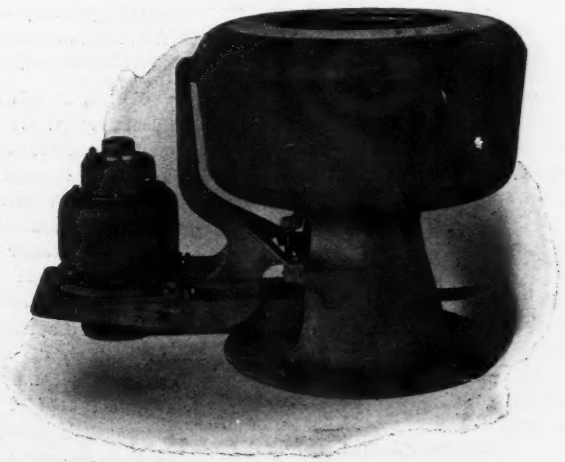


Western Electric Alternating-Current Bracket Fan Motor.

From a mechanical standpoint the blades are great savers of current, the angles at which they are built following specially designed lines, furnishing maximum breeze with minimum current consumption.

The Electric Drive in Laundries.

The accompanying illustration shows one of the applications recently made by the Crocker-Wheeler Company, of Ampere, N. J. This is a Crocker-Wheeler motor driving an extractor. The company is making a specialty of equipping laundry machinery. In addition to the advantages of economy of power, absence of belts, etc., the motor drive in the laundry secures the important advantage of cleanliness. There is always a possibility of dirt working into the machines where belts are used, and this has frequently caused a good deal of annoyance. By attaching a small motor to each machine, the belt may be entirely eliminated. In addition, a variety of speeds may be obtained to suit the different classes of work.



Electrically Driven Washing Machine

Demand for Copper Strong.

George Westinghouse, president of the Westinghouse Electric and Manufacturing Company, had this to say yesterday, says the New York *Sun* of April 16, regarding the consumption of copper by engineering interests:

"The situation as to the consumption of copper to-day is practically as it has been for a long time. There is nothing to warrant the belief that prices of the metal or conditions as to production and consumption of copper will be changed, except in an unimportant degree, for as far ahead as business men can see into this year's trade nothing but a commercial catastrophe can mar the present favorable conditions in the developments of our resources. It seems to us, judging from what is gathered from the principal miners and consumers of copper, that the steady gains of consumption over production in the world's supplies of copper are still progressing. So far as the consumption of copper by electrical engineering interests is concerned, there is a considerable increase, not only in this country, but in the other countries in which industrial activity is prevailing. There is now on the books of makers of electrical apparatus in America and Europe much more business than ever before. We do not hear from any important interest with which we do business anything about a recession in contracts. This applies to all lines of power machinery and collateral channels of trade."

The nineteen Lake Superior mines are estimated to have turned out 20,609,135 pounds of copper in March, against 18,607,753 pounds in February.—*Copper Gossip.*

Current Electrical News

DOMESTIC AND EXPORT.

PENNSYLVANIA RAILROAD TUNNELS TO BE READY IN 1908—Samuel Rea, third vice-president of the Pennsylvania Railroad Company, is authority for the statement that trains will be running through the company's tunnel between Jersey City, N. J., and Manhattan Island in December, 1908.

OHIO ROAD MORTGAGED—The Cleveland, Southwestern & Columbus Electric Railway Company, successor to the Cleveland & Southwestern, has filed a $10,000,000 mortgage in favor of the Cleveland Trust Company, Cleveland, Ohio, covering all the property of the corporation in the nine counties through which the road operates.

LARGE MORTGAGE FILED—A mortgage for $10,000,000, given by the Terre Haute, Indianapolis & Eastern Traction Company to the Fidelity Trust Company, of Philadelphia, Pa., has been filed at Terre Haute, Ind. The mortgage bears interest at five per cent and is payable in twenty years. It covers the interurban lines recently acquired by lease and building to connect Terre Haute with Indianapolis and Richmond, Ind. The lines pass through 108 towns.

NEW YORK, NEW HAVEN & HARTFORD'S ELECTRICAL TESTS—The single-phase electric trains of the New York, New Haven & Hartford Railroad have been operated between Larchmont and New Rochelle, N. Y., where tests are being made of the company's new overhead electric system. The tests are said to show that trains operated by the new system will be capable of a speed of 100 miles an hour with safety. The current is supplied from the company's power-house at Cos Cob, Ct.

WIRELESS TELEGRAPH NOTES—The Swiss government has constructed three important wireless stations on the Alps, of which one is on the Righi Mountain and the two others on Mounts Gottard and Scheidegg. The stations have been established principally for military purposes and the Righi is now connected by wireless with the Stokli fortress, a distance of fifty-three kilometres. It is proposed to establish a wireless station on the Simplon Mountain at an altitude of 2,000 feet, connecting Switzerland with the Vallese and the Oberland stations. The Marconi Company, Limited, is about to undertake some important developments. It has arranged to install a special station at Clifden, on the west coast of Ireland, and by that means to establish direct connection with the United States. Tests have already been made, and are said to have yielded satisfactory results. The system has in some important respects been improved upon, providing for a much greater distance of transmission.

PERSONAL MENTION.

MR. F. C. STANFORD, who for several years has been division superintendent of the Rocky Mountain Bell Telephone Company for the Central Idaho division, has resigned.

MR. C. R. FREDERICK, who has been connected with street railway enterprises in the western states for the past three years, has been appointed vice-president and general manager of the Johnstown, Ebensburg & Northern Railway, Johnstown, Pa., succeeding W. E. Hildebrand.

MR. CHARLES C. SHAFER has been appointed superintendent of the Perth Amboy division of the Public Service Corporation of New Jersey. Mr. Shafer is an experienced railroad man, having worked for the Public Service Corporation for a number of years in various places. He comes from Milltown, where he was last employed by the company.

MR. E. J. KULAS, secretary and general manager of the Brilliant Electric Company, Cleveland, Ohio, was a recent visitor to New York city, working on some of the details connected with equipping the company's new factory at Conneaut, Ohio. Mr. Kulas is anxious to push this work along, as the company finds it necessary to occupy its new quarters as soon as possible.

MR. ADELBERT R. WHALEY, superintendent of the New York division of the New York, New Haven & Hartford Railroad Company, it is announced, has accepted a newly created position with the New York Central & Hudson River Railroad Company. Mr. Whaley, who has had a large experience in the electric traction field, will be connected with the electric zone of the company.

DR. WILLIAM M. HABIRSHAW, president of the India Rubber and Gutta Percha Insulating Company, who has not been in the best of health for several months past, sailed last week for a two months' rest in European countries. Dr. Habirshaw is one of the best known men engaged in the manufacture of rubber-covered wire, and has built up a very large business. His many friends hope that he will return with his health fully restored.

MR. FREDERIC NICHOLLS, vice-president and manager of the Electrical Development Company of Ontario, Limited, Toronto, Ontario, has left for London, England, to consult the bondholders in connection with questions relating to contracts made with the Toronto Electric Light Company and Toronto Railway Company, a course which has resulted from recent deliberations between the city and the Dominion government on the power question.

MR. F. V. L. SMITH, who has had a wide experience in electrical construction, is now connected with the Sprague Electric Company, with headquarters in New Orleans. Mr. Smith was an electrical inspector of the Pan-American Exposition in 1901 and afterward was an electrical inspector for the National Board of Fire Underwriters in New York city until December, 1904, when he became chief electrical inspector for the Louisiana Fire Prevention Bureau, with headquarters in New Orleans, where he built up an excellent inspection system and gained an enviable reputation. Mr. Smith also holds the position of deputy fire marshal for the state of Louisiana. By his extensive knowledge of electrical work, including trolley operation, and acquaintance in the southern territory, Mr. Smith is well fitted to exploit the products of the Sprague Electric Company through the South.

MR. E. J. WILCOXEN, superintendent of transportation of the Rochester (N. Y.) Railway Company, has been made general superintendent of the company. He will also take over most of the duties of general manager until R. E. Danforth's successor is appointed. Mr. Wilcoxen entered the railroad service in 1888, when he was seventeen years old, as a clerk in the car service department of the Buffalo, Rochester & Pittsburg Railway, with headquarters in Bradford and Buffalo. After he had been advanced to a position in the office of the superintendent of the road he resigned and entered the service of the Wagner Palace Car Company, and eventually became secretary to the assistant manager, with headquarters in Buffalo. After he left the Wagner service he was, for two years, assistant superintendent of the Niagara Falls State Reservation. He was subsequently employed on the steam railroad that was operated between Waterloo, Seneca Falls and Cayuga Lake. That road was absorbed by the Geneva, Waterloo, Seneca Falls & Cayuga Lake Traction Company and electrified. Mr. Wilcoxen remained in the service of the new company until he became affiliated with the Rochester & Sodus Bay Electric Railway Company, as assistant superintendent of construction, nine years ago. He was promoted to general freight and express agent and two years ago to general superintendent. After the interurban line had been taken over by the Rochester Railway Company he became a division superintendent of the latter, and about a year ago was made superintendent of transportation.

ELECTRICAL SECURITIES.

Notwithstanding considerable dulness, the tendency in the market is toward improvement, with all parties concerned awaiting any development which will stimulate into greater activity the upward movement. Money continues easy, both at home and abroad, and in a month something definite will be known concerning the winter wheat crop and the outlook for the future of the spring planting. The railroad companies have succeeded in borrowing $300,000,000, mostly on short-time notes, during the present year, for necessary improvements and extensions. The rates for these loans are out of proportion with the security offered, and every effort should be made to lift the railways of the country out of the prostrate position, as far as borrowing is concerned, to which they have come through recent circumstances, to a point where they can secure money for betterment, at rates which their resources entitle them to.

ELECTRICAL SECURITIES FOR THE WEEK ENDING APRIL 27.

New York:	*Closing.*
Allis-Chalmers common	12
Allis-Chalmers preferred	32
Brooklyn Rapid Transit	59¼
Consolidated Gas	132½
General Electric	147
Interborough-Metropolitan common	25¼
Interborough-Metropolitan preferred	59½
Kings County Electric	126
Mackay Companies (Postal Telegraph and Cables) common (ex-dividend)	69⅞
Mackay Companies (Postal Telegraph and Cables) preferred (ex-dividend)	69⅝
Manhattan Elevated	136
Metropolitan Street Railway	100
New York & New Jersey Telephone	113½
Western Union	83
Westinghouse Manufacturing Company (ex-dividend)	143½

The annual meetings of the stockholders of the Interborough Rapid Transit Company and the New York City Interborough Railway Company will be held on May 8.

Western Union reports of messages for March, 1907, from districts throughout its field show 140 increases, out of 180 quoted, over March, 1906. Similarly the figures for March, 1906, show a gain over that month of 1905.

The Westinghouse Electric and Manufacturing Company will issue $5,000,000 new non-assenting stock. Stockholders of record May 4 will have the right to subscribe for the new stock at $75 a share. The stock has a par value of $50 a share and the company is therefore asking a premium of $25 a share. If the stock is all taken at the premium demanded, the issue will supply $7,500,000 of new funds, which will be devoted to improvements and extensions of the Pittsburg plant. The Westinghouse Company has notified stockholders that for the purpose of ascertaining the stockholders entitled to subscribe for the proposed new issue the transfer books for the preferred, assenting, and non-assenting stocks will be closed on May 4 and reopened on May 13.

At the annual meeting of the stockholders of the General Electric Company, to be held May 14 in Schenectady, stockholders will vote on amendments to the by-laws by striking out articles two, five and seven and substituting therefor a new article two. The amendments are in the direction of centralizing power in the hands of the president. The offices of first vice-president and comptroller are to be abolished, as also the requirement for the compulsory election of a chairman of the board of directors. The directors may elect such a chairman, but he will not be an officer of the company as at present.

Boston:	*Closing.*
American Telephone and Telegraph	124
Edison Electric Illuminating	208
Massachusetts Electric	58
New England Telephone	120½
Western Telephone and Telegraph preferred	70

The report of the Massachusetts Electric Companies for the quarter ended March 31 is as follows: gross, $1,526,523; expenses, $1,207,781; net, $318,742; charges and taxes, $436,152, leaving a deficit of $117,410. This compares with $90,838 for the same quarter of the preceding year. For the six months ending March 31 the total deficit is $41,890, comparing with $4,539 for the preceding year, and $177,598 for 1905.

Philadelphia:	*Closing.*
Electric Company of America	10
Electric Storage Battery common	53½
Electric Storage Battery preferred	53½
Philadelphia Electric	8⅝
Philadelphia Rapid Transit	22⅜
United Gas Improvement (ex-dividend)	92¾

An excellent report on its business for 1906 was submitted to the stockholders of the Electric Company of America at their annual meeting in Camden, N. J., on April 22. Net earnings aggregated $581,511, compared with $534,474 for 1905, while other income amounted to $11,454, compared with $4,716, making a total income $592,965, or $53,781 more than that for the preceding year. Charges to subsidiary companies involved $50,568, compared with $42,654 for 1905, leaving a balance of $542,397, compared with $496,536 for the previous year, showing an increase of $30,524. Dividend disbursements amounted to $299,780, or $14,245 more than those for 1905, and the surplus for the year aggregated $171,674, a gain of $16,249. The profit and loss surplus amounted to $1,099,324, or $171,674 larger than that of December 31, 1905. The shareholders also approved the suggestion of their directors to exchange the company's $5,000,000 of seven per cent stock for $6,000,000 of five per cent bonds of the Electric Bond and Share Company, as a preliminary step in the company's merger in the Electric Bond and Share Company, which is to be the holding company for the Electric Company of America and numerous other light, power and traction concerns in the central west. In view of the fact that the purpose of the special meeting to authorize the exchange of Electric Company of America stock for bonds in the new company required a two-thirds vote of stockholders, or about 300,000 shares, it was decided to postpone the special meeting, as the stock represented was 17,000 short of the two-thirds majority. The annual meeting was therefore adjourned until 11 A. M., June 5, for which time a special meeting will also be called. The full board of directors was elected as follows: A. Loudon Snowden, J. H. Catherwood, G. A. Cotton, S. G. Thompson, F. M. Walton, G. B. Roberts, J. E. Hayes, H. T. Hartman and H. S. Kerbaugh. The president stated in his report that all of the surplus has been expended on the property in extension and betterment.

Chicago:	*Closing.*
Chicago Telephone	130¼
Chicago Edison Light	143
Metropolitan Elevated preferred	65
National Carbon common	70
National Carbon preferred	114⅞
Union Traction common	—
Union Traction preferred	—

The directors of the National Carbon Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock payable May 15. Books close May 4 and reopen May 16.

OBITUARY NOTES.

MR. MICHAEL TRACY, formerly superintendent of the American Electric Light Company, Bloomsburg, Pa., died in that city on April 18, of consumption, after a long illness.

MR. WILLIAM J. JOHNSTON, publisher of the *American Exporter*, died on Sunday, April 28, at his home, 774 West End avenue, New York city. Mr. Johnston was born in Antrim, Ireland, in 1853, and came to New York in 1868, where he was first employed as a telegraph operator. He took up the publication of *The Operator* in 1874, and in 1883 began the publication of the *Electrical World* as a weekly, conducting it until 1899, publishing at the same time *The Operator*, which finally discontinued in 1884. He subsequently made a tour of the world, and later, early in the new century, took over the *Engineering and Mining Journal*, managing it until 1905, when he started the *American Mining Journal*, and, later, took charge of the *American Exporter*. Last year he made an extended trip to South American cities and made an analysis of export conditions, his reports being quoted very widely in the trade and technical press of every industry. He is survived by a widow, four sons and four daughters.

NEW INCORPORATIONS.

NORFOLK, VA.—Dillsboro & Sylva Electric Light Company. $10,000. To furnish power, light and heat in Jackson and other counties.

FRANKFORT, KY.—Green River Hydroelectric Company, of Warren county. An increase of capital stock from $22,000 to $150,000.

ALBANY, N. Y.—Warren Electric Company, of Brooklyn. $6,000. Directors: G. L. Warren, F. E. Kneelind, Jr., and G. S. Burr, of Brooklyn.

DENTON, TEX.—Denton Interurban Railway and Power Plant Company. $100,000. Incorporators: H. M. Griffin, W. W. Wilson, R. J. Wilson and Newt M. Lee.

ALBANY, N. Y.—Railway Traction Construction Company, New York. $100,000. Directors: M. A. Schenck, Robert Gebracht, Jr., and G. H. Fitzgerald, Brooklyn.

LANSING, MICH.—The Toledo & Western Railroad Company, of Sylvania, Ohio, and Adrian. $2,000,000. To build an electric railroad from Toledo to Adrian.

INDIANAPOLIS, IND.—Manufacturers' Plant and Power Company, South Bend. $100,000. Directors: Albert B. Wickizer, Philip E. Bondurant and Charles M. Kriegbaum.

COLUMBUS, OHIO—The Eaton Gas and Electric Company, Eaton. $200,000. Incorporators: Arthur H. Wyatt, W. W. Taft, George Hoyt, W. W. Hoyt and N. B. Martin.

KANSAS CITY, MO.—The Blue Valley Railway Company, of Kansas City. $100,000. Incorporators: Alexander Massey, Edwin L. Brown, Joseph S. Chick, Jr., and Willard E. Winner, of Kansas City, and John Georgen, of Independence.

AUSTIN, TEX.—The Home Telephone Company, of West, McLennan county; $25,000; incorporators, E. Rotan, A. F. Laullin, J. B. Earle, W. T. Glasgow and J. E. Boynton. Everman Telephone Company of Everman, Tarrant county; $5,000; incorporators, J. Martin Scott, J. L. Gantt and Dr. J. A. Hammack.

ALBANY, N. Y.—The Lake Champlain & Lake Placid Traction Company. $1,500,000. To build an electric road forty-nine miles long from Westport to Lake Placid and Ausable Forks. Directors: G. S. Raley, of Glens Falls; A. L. Washburn, of Hartford, Ct., and others.

MONTPELIER, VT.—The Topsham Telephone Company. $5,400. To construct and maintain a telephone system in the towns of Topsham, Corinth, Newbury, Bradford, Orange, Groton and Ryegate. Stockholders: O. P. Dickey, East Corinth; J. P. Dickerman and Eri Morrison, Groton; E. M. Hood, Topsham, and George W. Merrit, Groton.

LAKEPORT, CAL.—Sonoma & Lake County Railway Company. $1,000,000. To construct an electric railway from Cloverdale to Lakeport, with a branch to Kelseyville. Board of directors: M. C. Dickinson, of Ukiah, president; J. E. Fulton, vice-president; W. S. Fry, secretary; J. R. Garner, treasurer; J. W. Preston, J. A. Sparks, D. F. MacIntire, W. P. Merideth and W. N. Johnson.

BANGOR, ME.—The Island Telephone Company. $10,000, all of which is common stock. Officers: president, Guy H. Parker; vice-president, T. S. Tapley; treasurer, William J. Tower; directors, Seth W. Norwood, Guy H. Parker, William J. Tower, Henry Clark, George A. Neal, Lewis S. Springer, B. B. Reed, Lowell A. Bunker, Charles P. Lunt and T. S. Tapley.

BANGOR, ME.—The Searsport Electric Company. $50,000, all of which is common stock and of which $13,600 is paid in. For the purpose of making, generating, selling, distributing and supplying electricity in the towns of Searsport and Stockton Springs. Officers: president and treasurer, Amos Nichols; directors, Augustus J. Nickerson, Frank I. Pendleton, Amos Nichols and Daniel C. Nichols.

SPRINGFIELD, ILL.—Saline Valley Railway Company, Chicago; $50,000; incorporators and first board of directors, W. C. Brown, New York city; J. J. Paris, Harrisburg, Ill.; C. E. Schaff, E. T. Glennon and S. W. McCune, Chicago, Ill. Carlyle & St. Louis Railway Company, Carlyle, Clinton county, Ill.; $5,000; incorporators and first board of directors, Thomas E. Ford, Carlyle, Ill.; J. C. Eisenmayer, Trenton, Ill.; August J. Klutho, Breese, Ill.; B. H. Heimann, Aviston, Ill.; Henry Hummert, Breese, Ill.

TRENTON, N. J.—The Chicago Securities Corporation. $1,200,000. To produce and deal in natural and artificial gas and electricity for light, heat and power; also to supply municipalities with water. For these purposes it is given authority to string wires, erect poles and lay pipes. It may also acquire other corporations with their property, rights, privileges and securities, including power to hypothecate securities, such as government, state, county and municipal bonds. Incorporators: H. O. Coughlan, John O. Turner and Felix Ingold.

NEW MANUFACTURING COMPANIES.

LOCKPORT, N. Y.—A new electrical company has been started in this city to be known as the United Electric Company. Those interested in the new concern are F. G. Stone, who has been in the electrical business in this city for many years, and W. C. Winchester and R. A. Heim.

ALBANY, N. Y.—The Gunnion Electric Insulation Company, of Northport, has been chartered by the state department with a capital of $250,000, consisting of shares of $100 each. Of this amount the sum of $115,000 is to be seven per cent cumulative preferred stock. The directors are: James Gillin, D. W. Troy and W. L. Morris, of Brooklyn.

JERSEY CITY, N. J.—The Payne Electric Dredge Company, a $500,000 concern, has filed articles of incorporation at the county clerk's office in Jersey City. The company proposes to manufacture dredges and excavators. The incorporators are John Duncklee, John F. Scannell and Marvin H. Payne, all of New York. The registered office is at 15 Exchange Place, Jersey City.

ALBANY, N. Y.—The E. P. W. Manufacturing Company, of Cornwall Landing, has been incorporated at the office of the secretary of state. The capital is placed at $12,000. The directors are George G. Peck, John R. Westlake and J. Elwood Easman, of Newburgh. The company has elected Mr. Westlake president; Mr. Easman, vice-president, and Mr. Peck treasurer and manager. It will manufacture electrical appliances, namely, insulator pins and brackets, at Cornwall.

ENGINEERING SOCIETY NOTE.

CORNELL UNIVERSITY BRANCH AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The regular meeting of the Cornell University Branch was held on April 16, 1907, in the main lecture room of Franklin Hall. Dr. C. P. Steinmetz's paper on "Lightning Phenomena in Electric Circuits" was abstracted by J. C. Peebles, Professor E. E. F. Creighton's paper on "New Principles in the Design of Lightning Arresters" was read by E. D. Payne, and the secretary gave the results of the paper by D. B. Rushmore and D. Dubois on the "Multi-Gap Lightning Arrester." The advantages of a systematic method of abstracting papers was demonstrated. The meeting proved to be one of the most interesting of the year, and after the abstracts of the papers had been delivered a large number of local members took part in the discussion. Ninety members and visitors were present. Following the discussion a number remained for an informal smoker and further conversation regarding technical matters.

DATES AHEAD.

Jamestown Tercentennial Exposition. Norfolk, Va., April 26 to November 30.

West Virginia Independent Telephone Association. Annual meeting, Wheeling, W. Va., May 9-10.

Texas State Electric and Gas Association. San Antonio, Texas, May 14-16.

Virginia State Independent Telephone Association. Annual meeting, Norfolk, Va., May 21.

American Society of Mechanical Engineers. Annual meeting, Indianapolis, Ind., May 28-31.

National Electric Light Association. Annual meeting, Washington, D. C., June 4, 5, 6 and 7.

American Railway Master Mechanics' Association. Annual meeting, Atlantic City, N. J., June 12-14.

Pacific Coast Electric Transmission Association. Los Angeles, Cal., June 18-20.

Association of Railway Telegraph Superintendents. Annual meeting, Atlantic City, N. J., June 19-20.

American Society for Testing Materials. Annual meeting, Atlantic City, N. J., June 20-22.

American Institute of Electrical Engineers. Annual meeting, Niagara Falls, N. Y., week of June 24.

ELECTRIC RAILWAYS.

ROCK VALLEY, IOWA—A franchise has been granted the Sioux City & Ireton Railway.

EXCELSIOR SPRINGS, MO.—The ordinance granting a franchise to the Kansas City, St. Joseph & Excelsior Springs Railroad has been passed by the city council.

ENUMCLAW, WASH.—At a mass meeting of people of Enumclaw and vicinity subscriptions were raised for a preliminary survey for an electric line connecting with Auburn.

CEDAR RAPIDS, IOWA—The projected Iowa-Missouri Traction and Power Company's line from Memphis to Fairfield is proposed to be extended to Marengo, Vinton and Cedar Rapids.

TITUSVILLE, PA.—At a meeting of the Titusville Electric Traction Company the directors decided to extend the company's lines to Cambridge Springs and also to Oil City by way of Cherrytree.

COLUMBUS, OHIO—Officers of the new Columbus, Urbana & Western Electric Railway state that steps will be taken immediately to extend the line from Columbus through Hillards and Bellefontaine to Lima.

MORRISTOWN, N. J.—It is announced that the Morris County Traction Company has secured the right of way over the Dover, Rockaway & Hibernia Railroad at Rockaway. It is said that the privilege cost the traction company $10,000.

FREDERICK, MD.—A preliminary survey for the proposed electric railway line from Brunswick to Middletown has been completed. Starting in the new Baltimore & Ohio Railroad yards at Brunswick, the survey runs *via* Burkittsville to Middletown, a distance of thirteen miles, with no grades exceeding three per cent.

DENVER, COLO.—The improvement work provided for in the Denver Tramway Company's franchise measure, adopted last spring, is now under way. The directors have set aside $250,000 for immediate use and will follow this with other appropriations as fast as the money is needed. Ten miles of extension track will be laid and in operation by May 1.

GREENFIELD, MASS.—Preliminary steps toward organizing the Greenfield, Bernardston & Northfield Street Railway Company have been taken and these directors chosen: John Wilson, Lester A. Luey, A. D. Flower, of Greenfield; J. W. Chapin and E. E. Benjamin, of Bernardston; C. H. Webster, of Northfield, with one more from that town. The capital is to be $75,000.

HORNELL, N. Y.—According to President Lieders, of the Rochester, Corning & Elmira Traction Company, a spur of that line will be constructed from Dansville to Hornell. Mr. Lieders says that work on this line will begin within sixty days, and that it is hoped the first cars will be operated by August of 1908. Fast cars will be run over the line from Hornell to Rochester every hour.

BEAVER DAM, WIS.—Citizens of Hustisford, Neosho, Juneau and Beaver Dam are endeavoring to build an electric road from Oconomowoc to Beaver Dam, going through the above places. The capital will be furnished by Dodge county capitalists. Richard Roll, of Hustisford; Edward Beichl, of Beaver Dam, and Theodore Hemmy, of Juneau, have been appointed a committee to incorporate the road.

EASTON, PA.—The following directors were elected at the annual meeting of the Northampton Traction Company held at Easton: Chester Snyder, A. R. Dunn, S. Bixler, S. R. Bush, M. P. McGrath, William Bray, W. R. Grubb, W. J. Daub, W. O. Hay. The following officers were elected: president, T. A. Hay; vice-president, H. H. Haines; secretary, W. O. Hay; treasurer, Chester Snyder; superintendent, D. L. Beauleau.

MONROE, LA.—At a mass meeting of property owners who are interested in the extension of the street-car line to the locks and dams, the proposition agreed to by the joint committees of the city council and property owners was settled upon, as follows: That the city is to have use of $25,000 for ten years, without interest, and that the property owners are to donate $5,000 toward the expense of building the line.

SPRINGFIELD, MASS.—Announcement has been made that by July 1 there will be in operation a through line of trolley cars between Springfield and Worcester, and that this line will also enable passengers to travel between Springfield and Boston with only one change—at Worcester. The run from Springfield to Worcester by way of Palmer and the new line from that place to Fiskdale, connecting with the Worcester & Southbridge Street Railway, it is stated, will take three and one-half hours.

ATLANTIC CITY, N. J.—Stockholders of the Atlantic City & Suburban Traction Company have approved the directors' plan to save the company from a receivership by issuing $300,000 worth of preferred stock. Competition resulting from the opening of the new Pennsylvania trolley to Somers Point reduced the Suburban's earning capacity, and defaulted interest and other pressing claims forced action. More than 14,000 of the 15,000 shares of stock represented at the meeting were voted in the affirmative.

SAN DIEGO, CAL.—As a result of a conference between John D. Spreckels and D. C. Collier, president of the Point Loma Electric Railway Company, the San Diego Electric Railway Company will build and operate the line for which the Point Loma company has secured a franchise. The expense of building will be charged to the Point Loma company. William C. Clayton, vice-president and managing director of the Spreckels companies in San Diego, stated after the conference that work would be commenced on the line, which will be six miles long, as soon as material could be secured.

DEFIANCE, OHIO—Contracts have been awarded by the Schoepf traction syndicate to an Indianapolis company for the construction of thirteen concrete bridges to replace wooden structures along the line of the Columbus & Lake Michigan steam road in operation between Defiance and Lima, recently purchased by the Schoepf syndicate. Many improvements are about to be made on the line preparatory to its electrification. Contracts have been let for the extension from Lima to Bellefontaine, and work commenced. This will give a direct line from Defiance to Columbus *via* Lima and Bellefontaine.

MANISTIQUE, MICH.—With the announcement that Chandler's Falls, Escanaba river, have been taken over by Appleton and Mariette, Wis., capitalists who propose to develop the water power and build and operate a big pulp mill on the site, there has been revived an interurban project which contemplates an electric line extending from Manistique to Garden, thence to Escanaba, and eventually to Menominee. The proposed line between Menominee and Escanaba was surveyed two years ago, and that between Manistique and Garden had been planned for construction this year. It is estimated that Chandler's Falls are capable of the development of 7,000 horse-power.

COLUMBUS, OHIO—At a meeting of the stockholders of the Findlay-Marion Traction Company, these officers were elected; president, R. P. Hanke, Detroit; secretary and treasurer, G. W. Meeker, and general counsel, Emmett Tompkins. The company has been capitalized for $250,000, and this will be increased to $1,250,000 in the near future. The right of way, which has been secured, extends from Marion to Findlay, a distance of forty-seven miles. It will connect at Marion with the Columbus, Delaware & Marion, and at Findlay with the Toledo, Bowling Green & Southern, giving a direct route from Columbus to Toledo. The finances have been arranged for in the East and work will begin on the construction immediately.

ALBANY, N. Y.—The United Traction Company, of Albany, has been granted permission by the state railroad commission to issue $500,000 bonds on its consolidated mortgage for $6,500,000, which was authorized in 1905. After the $500,000 bonds are issued there will yet remain a balance unissued of $859,000, which can not be put out until permission shall be given by the commission. In its petition to the commission for authority to make the issue of the bonds at this time the company announces that there has been expended for extension of lines, acquisition of additional properties and various improvements since January 1, 1906, $410,000. To complete the work in this line now under way will require $155,000. Besides the big expenditures mentioned, the company has contracted for new cars, the cost to fully equip which for running on the line will aggregate $108,000. The company also has contracted for new converters and transformers at a cost of $8,600. The proceeds of the sale of the $500,000 bonds will be applied to the company's improvements now under way.

ELECTRIC LIGHTING.

PERRY, IOWA—The Perry Electric Light, Power and Heat Company has ordered additional machinery for a day circuit.

LOWVILLE, N. Y.—The village has voted to acquire the existing system of the Wetmore Electric Company, at an expense not to exceed $85,000.

ERIN, TENN.—Erin is soon to have an electric light and ice plant, which will run in connection with the water plant that is now in operation.

COLORADO SPRINGS, COL.—Colorado Springs has voted to issue bonds to the amount of $150,000 for the establishment of a municipal electric light plant.

FORT DODGE, IOWA—The electric light franchise carried at the election at Moravia by a vote of seventy-four to twelve. Davenport capitalists are back of the project.

SAN FRANCISCO, CAL.—Fire destroyed property of the San Francisco Gas and Electric Company, valued at $2,500,000, on April 3. Over one-third of a $7,000,000 plant was burned.

LOWELL, MASS.—The Stone & Webster Engineering Corporation, of Boston, will spend nearly $25,000 in expanding the plant of the Lowell Electric Light Corporation, in Perry street.

HAMBURG, PA.—Hamburg's town council has renewed its contract for five years with the Hamburg Electric Light, Heat and Power Company to furnish lights at $80 per arc lamp per annum.

RICHTON, MASS.—The mayor and board of aldermen have given the Richton Lumber Company an electric light franchise, and contracted for the lighting of the town for a period of five years.

TOPEKA, KAN.—The Topeka Electrical Company sent in a petition to the council stating that the company could not go ahead with its plans and asking that the $2,500 guarantee deposit be returned. The council voted to grant the petition.

TOPEKA, KAN.—R. W. Freeman, of the electrical department of Kansas University, has been authorized to make plans, specifications and estimates for the rebuilding of the city electric light plant to a capacity of 500 lamps. The plant now has a capacity of only about 342 lamps.

UTICA, N. Y.—The stockholders of the Utica Gas and Electric Company at their annual meeting elected these directors: Anthony N. Brady, William E. Lewis, John C. Brady, Samuel A. Beardsley, W. T. Baker, Charles B. Rogers, John F. Maynard, Charles S. Symonds and M. J. Brayton.

NEWBURGH, N. Y.—A contract has been made with the Newburgh Light, Heat and Power Company for the lighting of the village. The number of lights to be used is fifty-four; six more than have been used in the past, and the price is to be $900. The lights are to be run until one A. M. every night.

FORT WORTH, TEX.—A movement is now on foot to reorganize the Arlington Electric Light and Water Company, capitalize with ample capital and install a first-class lighting and waterworks system. W. M. Dugan and associates have purchased the interest of Mr. Collins, who has been one of the principal stockholders for years, and also manager.

ANNISTON, ALA.—The Alabama Power and Electric Company has been incorporated in Talladega with a capitalization of $75,000 paid in and the privilege of increasing to $300,000. The company embraces the Talladega Electric and Power Company and the Little River Power Company, its purpose being to furnish water power for a large part of northeastern Alabama. The officers of the company are: J. H. Hanson, president; J. D. Mortimer, first vice-president, both of New York; R. H. Mitchell, Alabama City, second vice-president; A. E. Smith, New York, treasurer. Besides these gentlemen, the other stockholders are: H. W. Sexton, of Anniston; H. A. Barr, New York; J. K. Dixon, Talladega; H. H. Dean, New York, and R. J. McClellan, New York. The new company combines the franchises of both the Talladega company and the Little River company, which were organized for the purpose of lighting by electricity and gas and for the development of power for cars and manufactories. The prime movers in the organization of the company were H. W. Sexton and R. H. Mitchell.

TELEPHONE AND TELEGRAPH.

BESSEMER, COL.—A new switchboard has been installed at the Minnequa telephone exchange.

HOBOKEN, N. J.—The New York & New Jersey Telephone Company is now installed in its new building. The new switchboards have been designed to handle ultimately about 10,000 subscribers.

MORELAND, ARK.—A telephone company has been organized at Moreland, the following officers being elected: U. Hudlow, president; R. H. Vaughn, vice-president; T. B. Ludwick, secretary; F. N. Duvall, treasurer.

PLYMOUTH, N. H.—The Baker's River Telephone company announces that its system will be extended the coming summer, including a line up the Pemigewasset valley.

PHILADELPHIA, PA.—The Bell Telephone Company of Philadelphia, has announced a reduction in its rates for local pay station calls to five cents to all points in the city except from pay stations in hotels, where ten cents will still be charged. Sixteen thousand stations are affected by the order.

NEW YORK, N. Y.—At the annual meeting of the stockholders of the Marconi Wireless Telegraph Company of America the retiring directors were reelected with the exception of H. H. McClure and L. L. Smith, who resigned and who were succeeded by H. G. Matthews and G. T. Campbell, respectively.

SPOKANE, WASH.—Stockholders of the Waitsburg Rural Telephone Company have granted a ten-year lease of the system to the Pacific States Telephone Company. The system comprises twenty-one lines and 200 instruments. According to the lease the contract can be terminated at the end of a year if the service is not satisfactory. The Pacific States company is to keep the system in repair and charge the rural stockholders a fee of twenty-five cents a month.

OKLAHOMA, OKLA.—Shareholders of the Pioneer Telephone and Telegraph Company, of Oklahoma City, have authorized an issue of new stock to be distributed among themselves on a basis of three shares of the new issue for each share of old stock. The American Telephone and Telegraph Company took out $1,518,000 of the Pioneer company's common stock at par on April 1 and used the proceeds to reduce the floating debt by that amount. The Pioneer company's capital stock is now $2,473,200.

COOPERSTOWN, N. Y.—The Cooperstown & Cherry Valley Telephone Company has been absorbed by the East Springfield Telephone Company, the latter having purchased seven-eighths of the stock of the Cooperstown & Cherry Valley Company. The business will be continued under the name of the East Springfield Telephone Company, with the following officers: president, H. P. McDonough, of Cooperstown; secretary, A. B. Cox, of New York; treasurer, Henry Raphbun, of East Springfield.

SPOKANE, WASH.—The Pacific Telephone and Telegraph Com and the Wyoming & Sullivan Telephone companies have consolidated. The officers of the new company are the following: president, James McCloskey, of Dallas; vice-president, Dr. N. C. Mackay, of Waverly; secretary and manager, W. D. Gay, of Orange; directors, M. L. Perrin, R. M. Hughes and John H. Foy, of Pittston; H. S. Harding, of Tunkhannock; E. W. Thompson, of Factoryville, and A. D. Dean, of this city. The capital will be $120,000.

SPOKANE, WASH.—The Pacific Telephone and Telegraph Company and the Farmers' Company, of Wenatchee, Wash., west of Spokane, have come to an agreement after a conference by G. B. Bush, of San Francisco, and F. R. Bingham, of Spokane, with officials of the last-named concern. Under the provisions of the understanding the Pacific company is to turn over its local and long-distance business at once, and the two systems will be combined as soon as the change can be made. A three-section, multiple, common-battery switchboard will be installed and a new long-distance section will be put in. The Pacific company agrees to remain out of the local field for ten years. The Farmers' company is now constructing a line from the Dunkard settlement to Monitor. The company was incorporated in 1903. Z. A. Lanham is president and H. C. Littlefield is secretary.

INDUSTRIAL ITEMS.

THE GOULD STORAGE BATTERY COMPANY, New York, N. Y., announces that on June 1 it will move its offices from No. 1 West Thirty-fourth street to No. 341-347 Fifth avenue, corner of Thirty-fourth street.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., has ready for distribution price list No. 8. This covers the complete line of Paiste specialties. The list gives the catalogue page number, the catlogue number, the schedule, the standard package contents, and the list price.

GEORGE P. HUTCHINS, New York city, announces that on May 1 his business was removed to 500 Fifth avenue, New York city. Mr. Hutchins is conducting a very successful technical advertising bureau, and has among his clients a number of manufacturers of electrical apparatus.

THE GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., announces that its San Francisco office is now permanently located in the Union Trust Buliding, in San Francisco. Since the fire, the office has been located in the Union Savings Bank Building at Oakland, large temporary warehouses having also been erected in the same city.

THE MASSACHUSETTS CHEMICAL COMPANY, Walpole, Mass., operating the Walpole Rubber Works, the Walpole Varnish Works and the Electric Insulation Laboratory, has published a very complete catalogue and price list of insulating materials. The text of this catalogue should prove of great interest to any one interested in this subject.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., has published some very interesting literature which will be sent to any one interested upon request. This literature includes mailing cards concerning individual motors, and a blotter describing the Western Electric generators. Two folders call attention to ventilating apparatus and ceiling fans. An interesting booklet gives facts concerning the Western Electric Company, and a bulletin contains instructions for the installation and maintenance of telephone machines.

THE FARR ELECTRIC EQUIPMENT COMPANY, Chicago, Ill., has been organized to do a general electrical supply business, having already secured several good agencies for different lines of electrical goods. This company will manufacture and put on the market the Farr electric deep-sea sounding apparatus. Charles W. Farr, founder and president of the Farr Telephone and Construction Supply Company, has resigned the presidency and management of this company to become the president and manager of the Farr Electric Equipment Company. Offices will be located at 170-172 West Adams street, Chicago. The other members of the company are N. B. Farr, vice-president, and H. R. Cirvis, secretary.

THE GREEN FUEL ECONOMIZER COMPANY, Matteawan, N. Y., has found it necessary to remove its Chicago office from the Monadnock Block to the Old Colony Building, in order to secure more room. This company has been especially active in mechanical draft work for boiler plants, and has recently installed some of the largest over-hung wheels ever built, notably the eighteen-foot, six-inch by six-foot wheels supplied to the Grand Rapids Railway Company, and the nineteen-foot, six-inch by seven-foot wheels installed for the St. Louis & Suburban Railway. Besides mechanical draft work the company is doing a large business in heating and ventilating apparatus, and in artificial drying outfits for brick yards, wood-working plants, paper mills and other industrial establishments.

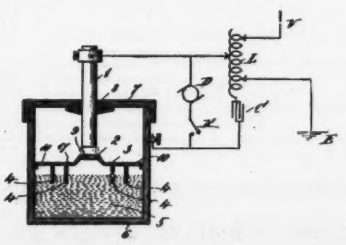
THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., has published a valuable booklet entitled "A Study in Graphite." This booklet gives in detail a series of tests of graphite made by Professor W. F. M. Goss, of Purdue University. These tests were not made with a view of finding points for or against graphite, but were conducted in the spirit of scientific research. The study opens with a dissertation by Professor Goss, based upon the conclusions drawn from the tests. This is followed by complete descriptions of the tests, with illustrations of the testing machine. The condition of the bearings and journal is shown by photographs taken at different stages of the test. Because of the high character of the matter and the heavy expense attached to the conducting and publication of these tests, it has been decided to make a nominal charge of twenty-five cents a copy. A limited number of copies, however, will be distributed free to parties interested in the science of graphite lubrication.

Record of Electrical Patents.

Week of April 23.

850,904. ELECTRIC CURLING-IRON. Jacob L. Burgard, Chicago, Ill., assignor of one-half to Herman Bollin, Chicago, Ill. Resistance coils are placed inside the jaws.

850,912. PROCESS OF MAKING ARTICLES BY ELECTROPLATING. Thomas A. Edison, Llewellyn Park, Orange, N. J. A film of copper is deposited, coated with iron and then removed.



850,917.—SPACE TELEGRAPHY.

850,913. SECONDARY BATTERY. Thomas A. Edison, Llewellyn Park, Orange, N. J., assignor to Edison Storage Battery Company, West Orange, N. J. An escape gas tube is attached to the casing.

850,917. SPACE TELEGRAPHY. Lee de Forest, New York, N. Y., assignor to George K. Woodworth, Boston, Mass. The electric arc is surrounded by steam.

850,924. ELECTRIC HEATER. Edward E. Gold, New York, N. Y. A car heater.

850,926. ELECTRIC MOTOR. John B. Gury, St. Louis, Mo. A reciprocating cutter driven by a motor.

850,927. CLOTH-CUTTING MACHINE. John B. Gury, St. Louis, Mo. A reciprocating motor-driven, cloth-cutting knife.

850,928. CLOTH-CUTTING MACHINE. John B. Gury, St. Louis, Mo. A motor-driven, cloth-cutting machine mounted on a standard.

850,937. AUTOMATIC CONTROL SYSTEM FOR ELEVATORS, ETC. Benjamin N. Jones, East Orange, N. J., assignor to Marine Engine and Machine Company, Harrison, N. J. The starting resistance is controlled by a number of electromagnets.

850,947. CONTROLLING DEVICE FOR ELECTRIC MOTORS FOR DRIVING SEWING-MACHINES, SMALL LATHES, ETC. Albert H. Midgley and Benjamin Reed, London, England. A small starting rheostat.

850,972. WIRELESS RECEIVING APPARATUS FOR EXPLODING MINES. Ferdinand Schneider, Langenfeld, Germany. Horizontal receiving wires are attached to the mine.

851,024. FIXTURE FOR ELECTRIC LAMPS. James B. McGinley, Allegheny, Pa., assignor to National Metal Molding Company. A lamp socket.

851,027. SPARK-COIL. Charles P. L. Noxon, Syracuse, N. Y. A plurality of electromagnetic means is provided for interrupting the primary circuit.

851,031. ELECTRICAL-IMPULSE-COUNTING SWITCH. Homer J. Roberts, Evanston, Ill. The local circuit is closed by the movement of a ratchet.

851,032. ELECTRIC FUSE. Ulysses G. Rogers, Columbus, Ohio, assignor to Jacob Bernhard, Columbus, Ohio. The fuse is passed through a folded strip of insulating material.

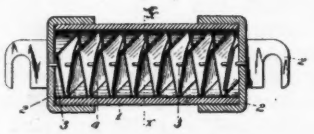
851,046. MAGNETIC ORE-SEPARATOR. Henry H. Wait, Chicago, Ill., assignor to International Separator Company, Chicago, Ill. The separation is effected without a fluid.

851,051. HEAT-COIL. Arthur H. Adams, New York, N. Y., assignor to Western Electric Company, Chicago, Ill. Uses a heat cartridge.

851,071. AUTOMATIC TELEGRAPHY. Albert C. Crehore, Tarrytown, N. Y., and George O. Squier, Washington, D. C. A synchronous system employing perforated tape.

851,086. DOOR-CONTROLLED ELECTRIC ELEVATOR SYSTEM. Richard H. Gay, Conesville, Iowa. The controlling solenoids are released by a switch closed by the door.

851,090. TELEPHONE METER. Newman H. Holland, Brookline, Mass., assignor, by mesne assignments, to Charles Bate, Boston, Mass. The operating member responds to changes in the character of the current.



851,032.—ELECTRIC FUSE.

851,111. APPARATUS FOR CLEANING SHIPS. Charles E. Arnold, Brunswick, Ga. A rotating cleaner is held against the hull by electromagnets.

851,149. LEAKAGE INDICATOR FOR HIGH-TENSION LINES. Jonathan E. Woodbridge, Rugby, England, and John B. Taylor, Schenectady, N. Y., assignors to General Electric Company. The indicator is inductively related to the system.

851,157. ELECTRIC FUSE OR CUT-OUT. Leonard B. Buchanan, Woburn, Mass. An enclosed fuse.

851,174. TELAUTOGRAPH. Arthur Korn, Munich, Germany. A photographic recording instrument.

851,175. DUMB-WAITER AND ELEVATOR. Louis E. Laurent, Trenton, N. J. The elevator is driven by an electric motor.

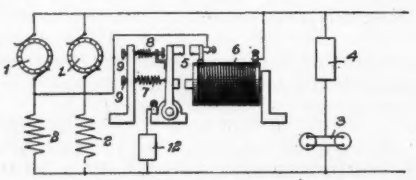
851,239. CONTROLLING DEVICE FOR ELECTRIC MOTORS. John D. Ihlder, Yonkers, N. Y., assignor to Otis Elevator Company, Jersey City, N. J. A compound motor provided with an additional field circuit.

851,291. STARTING DEVICE FOR HOISTING MACHINES. John D. Ihlder, Yonkers, N. Y., assignor to Otis Elevator Company, East Orange, N. J. Two starting resistances are employed, one normally cut out of circuit.

851,336. TRANSMITTER FOR WIRELESS TELEGRAPHY. Georg von Arco, Berlin, Germany. An open oscillation circuit is combined with an earth circuit.

851,340. MEANS FOR BONDING ELECTRIC CONDUCTORS. Harold P. Brown, Montclair, N. J. The bond is brazed to the rail.

851,353. PRIMARY BATTERY. Charles E. Hite, Burlington, N. J., assignor of one-fourth to Thomas J. Byrne, Philadelphia, Pa. A plunge battery, the liquid being raised to the electrodes by air-pressure.



851,461.—VOLTAGE REGULATOR FOR SERIES-WOUND MACHINES.

851,355. TELEPHONE TRANSMITTER. Stephen C. Houghton, Rome, N. Y., assignor to the Wire and Telephone Company of America, Rome, N. Y. The face-plate has an inwardly extending circular groove.

851,375. SUPPORT FOR ELECTRIC CABLES. George G. Raymond, New Rochelle, N. Y. Curved tubular supports.

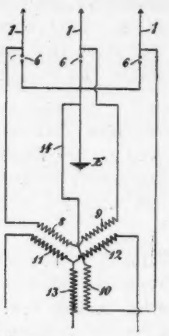
851,392. LIGHTNING ARRESTER. Alton W. Ball and Mark T. Seymour, Stow, N. Y. An air-gap arrester.

851,402. DRY BATTERY. Samuel Cochrane, Jersey City, N. J., assignor to Lincoln Electric Company, Jersey City, N. J. The cup is of porous material, coated with a non-absorbing compound.

851,403. ELECTRIC-LIGHTING DEVICE. Antone M. Cornelius, Chicago, Ill., and Willoughby V. Champlin, Rochester, N. Y., assignors to Abet Manufacturing Company, Chicago, Ill. An electric igniter.

851,410. ELECTROTHERMAL SWITCH. John Erickson, Chicago, Ill., assignor to Automatic Electric Company, Chicago, Ill. A telephone switch.

851,415. TROLLEY. Charles Y. Haile, Uniontown, Pa. The harp is provided with guard-arms.



851,621.—WIRELESS SIGNALING SYSTEM.

851,420. ELECTROTHERMAL SWITCH. Richard B. Hewitt and James G. Nolen, Chicago, Ill.; said Nolen assignor to Frank B. Cook, Chicago, Ill. A thermostat which opens the circuit when the temperature rises.

851,440. ELECTRICAL HEATING ELEMENT OR RESISTANCE. Edward G. Rivers, Richmond, England. The resistance material is placed in a grooved clay plate.

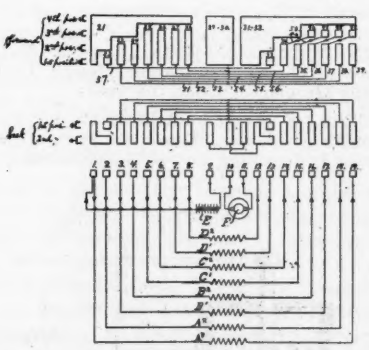
851,458. PARTY-LINE TELEPHONE SYSTEM. Felton Vollmer, Winsted, Minn. The talking circuits are controlled by a clock mechanism.

851,461. VOLTAGE REGULATOR FOR SERIES-WOUND ELECTRIC GENERATORS. James W. Welsh, Edgewood Park, Pa. A shunt to the field circuit is opened and closed by a magnet.

851,467. MEANS FOR PREVENTING SPARKING. Frank W. Wood, Newport News, Va. A plurality of coils is provided.

851,500. TELEPHONE TRUNKING SYSTEM. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. The supervisory trunk signal is operated by current flowing over a portion of the talking circuit.

851,506. ELECTRIC FIRE-ALARM. William H. H. Everett, Newton Falls, Ohio. A fluid thermostat.



851,633.—ELECTRIC CONTROL MECHANISM.

851,621. WIRELESS SIGNALING SYSTEM. Simon Eisenstein, Berlin, Germany. Multiphase alternating currents are used for signaling.

851,627. SHADE AND REFLECTOR FOR ELECTRIC LIGHTS. Benjamin F. Norton, Eagle Grove, Iowa. A conical shade.

851,632. MOTOR. Paul Synnestvedt, Pittsburg, Pa., assignor to Synnestvedt Machine Company, Pittsburg, Pa. The coil for each field pole is composed of sets of parallel strands which may be commutated.

851,633. ELECTRIC CONTROL MECHANISM. Paul Synnestvedt, Pittsburg, Pa., assignor to Synnestvedt Machine Company, Pittsburg, Pa. A plurality of separate windings, oppositely disposed, placed on the field.